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April 7, 1934

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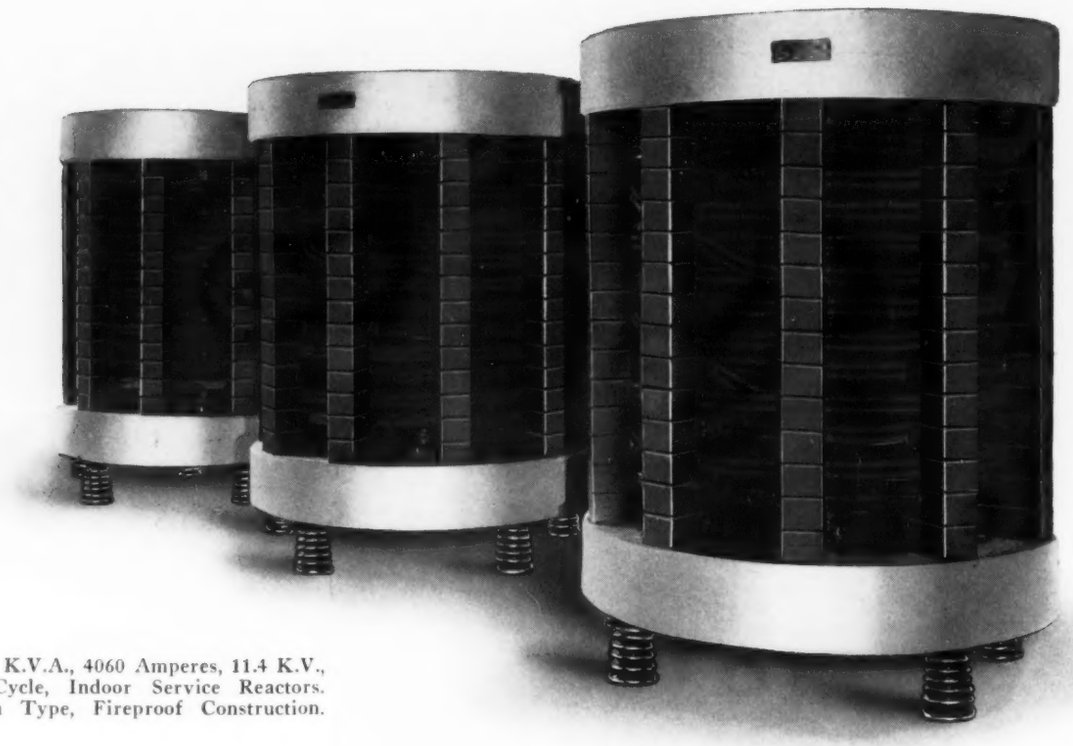

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ELECTRICAL WORLD

A consolidation of Electrical World, Electrical Engineer and American Electrician

What in the World!

There was a fine spirit manifest at the E.E.I. engineering committee meetings in Cleveland last week. We liked it. We particularly warmed to the obvious revival of some of the more industry-helpful activities that flourished under N.E.L.A. and were so long ruled out under E.E.I. Engineers must exchange ideas and experience data.

●

Here is a thought from the meeting. How many poles per customer should a utility have? Among three important Eastern properties, two within a few miles of each other, the figures run 4.4, 2.1 and 0.6. Figure that out in dollars per customer as contributing to system investment and fixed charges and it is obvious that one is nearer right on some basis than another.

●

For nearly a week we have had to take seriously those friends who dash up excitedly and ask, "What do you think about the Senator Thayer-Associated Gas & Electric letters?" Aside from the ready recognition of the purposes of political publicity, our best thought has to do with the old saw running, "Do right and fear no man; don't write and fear no woman!"

●

A well-known author of popular inspirational books wrote us this week saying that he was preparing a volume on opportunities for careers and then "I should like to have your opinion as to whether the elimination of smoke offers much opportunity for high-grade workers." Stack or tobacco? There have been a lot of people quite purposeful in the suppression of both.

L. W. W. MORROW, Editor

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JAMES H. RUDD
Manager

April 7, 1934

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for the Week Ending

April 7, 1934

L. W. W. MORROW, *Editor*

A NEW SPIRIT IN E.E.I.

How to build lines, how to prevent diversion of energy, how to protect equipment, how to reduce costs and how to maintain service. These were typical subjects discussed by engineers at the meetings of the Edison Electric Institute committees in Cleveland last week. More than 200 engineers interchanged opinion, facts and experiences. They were concentrating upon definite installation, maintenance and service aspects of the business. No one who attended the meetings could fail to reach two significant conclusions. The first is that engineers have large opportunities to make economies in the conduct of the utility business and the second is that it is essential that engineers get together to discuss their problems and experiences in order to bring about the economies.

It is encouraging to note that officials of the E.E.I. are welcoming plans to make committee activities more effective, to develop the service aspects of the association and thus to bring about improvements in field operations and in the morale of the personnel on the firing lines. The engineers, the accountants, the commercial men and the operating executives are key groups. They must and should have an organization that will permit them to get together and work effectively as groups. From them come the facts and the ideas that reflect actual conditions and that offer opportunities for senior executives to develop needed policies. The Edison Electric Institute should be built from the ground up and not from the top down if it is to be effective in these critical times. Knowledge of this fact now exists, and it is to be hoped that the several industry groups will suggest the organization changes that will make the new conceptions effective.

Visits to the field and talks with men in all positions give evidence of a revival of spirit and a changed attitude in utility ranks. Almost unanimous agreement exists that it is time to abandon a negative attitude and a defensive position. Neither prosperity nor a changed public sentiment will result from inertia or from pleadings for mercy. The men on the firing lines are getting into a fighting mood. They wish to take the aggressive and to deal with their problems constructively. They believe it to be necessary to admit the facts, to discard old forms of organization, old methods and old attitudes that conflict with valid conditions encountered today. In many instances they challenge the competency of the present executive leadership of the industry, in other instances they are disappointed at the forms this leadership takes, and in general they claim that the industry is drifting along too complacently. Undoubtedly there is a lack of information and a lack of understanding upon fundamentals.

Both the executives and the men on the firing line are to blame. Both must work together to improve the situation. The meetings at Chicago and at Cleveland are indications that this teamwork is developing. Keep it up.

HOW MUCH

Rate studies are far more prevalent than consumers realize; in fact, they are an almost continuous performance these days. Philadelphia Electric, for example, during the last three years has had various rate adjustments under consideration from six to eighteen months before they were put into effect; the delays were largely due to the decision to wait and see how likely and how drastic some new form of taxation might be. The making of customer-bill analyses to discern the effect of some new rate is

a fairly expensive matter even when short cuts are taken.

Short cuts most commonly employed are to take an average month's bill of all customers involved or to make random selection of a small fraction of all the cards for twelve months. According to the law of probability, the latter should give a good index unless too few samples are taken. Actually, however, there is considerable risk in taking, say, every tenth card on a geographical or alphabetical basis. There are so many variables as to length of month, individual consumer variations due to illness, travel, entertainment, etc., that the distribution of block consumptions for the samples may differ materially from the total group values. Further, the short cut of taking a year's consumption may obliterate the significant effect of seasonal variations under block rates. Nor is taking April or November or even both for all customers likely to give a sound index, because the drives for load building are more and more toward devices that find the greatest use in either summer or winter and not primarily in spring or fall.

Any tally method has the further defect that it is expensive if several trial rates are to be checked. On the whole, it appears that some mechanical tabulator should find application here to overcome the clerical disruption, the uncertain validity of sampled data and the difficulty of making several alternative trials using the same identified tally data. There is precious little literature on the technique of rate analyses. There is call for more of it.

HOW FAST?

Composite depreciation figures have found most favor with utilities because they are all that are needed for most purposes. Despite the logical use of a composite rate for the purpose of creating a reserve, some items will actually depreciate at a rate much faster than the composite rate, whereas others do so at a rate slower than the composite rate. But that rate of depreciation can generally be fairly accurately determined by an engineer thoroughly conversant with the particular phase of the art and with all phases of its development. If now one is confronted by a piece of equipment that has been in service, say, ten years, and if the composite rate on the system is, say, 3 per cent, it may be that the replacing equipment is not enough of an improvement to cover its own fixed charges and the amortization charges on the 70 per cent apparently remaining life in the old equipment.

But suppose the actual depreciation has been at an average rate of 7½ per cent. It is apparent that if one will only recognize this, the new investment may be able not only to carry its own fixed charges and the amortization of the actually remaining 25 per cent life but, in addition, show a handsome profit. Thus, by merely giving recognition through a proper accounting entry to what has actually taken place cumulatively over a period of years, the economics of a system will not only be put on a much sounder basis but, what is more important, service will not be hindered during a period when improvements should and can be made to help service and help liquidate the true remaining life in obsolete or depreciated apparatus or equipment.

Too much devotion to composite figures is likely to lead one astray on the economics of replacement and rehabilitation. More attention should, for these purposes, be paid to individual rates on separate items of equipment.

FUSES

"That is equivalent to a 10 per cent cut in three $1,800 salaries," an economy-minded speaker assured a recent Northwest Electric Association meeting. By using a $500 fuse installation in place of a $4,000 to $5,000 breaker on a 66/11-kv. rural service a capital outlay of about $4,000 was avoided with a saving of $500 a year and made it possible to avoid that much salary trimming as a way to a balanced budget. That's one way to keep the staff loyal and eager and similarly a way to escape the accusation that the extravagances of the boom period are being perpetuated.

Ten or twelve years ago such a suggestion—supplanting a breaker by a fuse—would hardly have been received with favor. As E. F. Pearson of Northwestern Electric Company put it, just before he made the above comparison: "We were sick and tired of fuses. Every time it rained a fuse would blow; when the wind would blow the fuse would blow; when a truck would roll by the transformer installation the fuse would break; if a crow landed on the fuse cutout he would put the whole district out of service. So we naturally drifted into using circuit breakers."

Today there is just as natural a drift back to fuses because fuse manufacturers got busy. Fuses are not yet so complete a substitute for the

breaker that the breaker is doomed to prompt museum confinement. But stringent economy is proving a great factor in focussing attention on the progress of the fuse. What Mr. Pearson said was in discussion of a paper in which appeared the following: "A great many manufacturers are very lax in furnishing engineering data on their fuses—such as time-current characteristic curves, rupturing capacity at various voltages and recommendations for various installations." It is barely possible that fuses have recovered quite a bit faster than their reputations. Makers' helpful information could join users' economy in forcing a fair answer —which shall it be, a fuse or a breaker?—in those situations where either might be used.

CAMPAIGN

Industrial power and steam supply to grouped manufacturing plants involves many problems. The costs associated with such service may well be studied on the basis of reaching multiple solutions according to the anticipated changes in customer numbers, demands, use of byproduct heat, initial conditions, absorption of surplus capacity in the utility system and ultimate inadequacy of industrial boiler plants and prime movers. In other words, if costs are computed for a group development at different stages, the decision as to purchasing electricity and industrial steam as an over-all service will rest upon a broader base of inquiry than where a finding is made on one set of conditions or limited outlook.

Putting it another way, the power sales department which plans a campaign rather than a single battle stands a better chance of winning a permanent victory, the campaign being an economic attack on combinations of plant conditions and not so much an assault on a momentary load and cost position. To be able to set forth comparative costs of service under a wide range of group circumstances is to reveal true professional mastery of industrial sales engineering.

IMPULSE

Recent agreement on impulse waves and impulse voltage standards should clear the air for orderly progress on insulation co-ordination for terminal apparatus. First, there was reported at the Cleveland E.E.I. meetings the adoption of the 1x5 and 1½x40 microsecond waves. By this act the ½x5 and the 1x10 microsecond waves are retired; there was always some doubt about the fidelity with which the ½x5 wave could be established and reproduced. Second, the positive wave is stipulated. Third, the square-rod gap becomes the standard for calibration of impulse voltages. Finally, the flashover values of insulator strings up to twenty units have been set for both types of waves.

From these foundations it is expected that the trend will be toward fixing three levels for the nominal voltage ratings of equipment for each particular operating voltage. One of these will correspond to the rod-gap protection. Another to the arrester applied at its full rated impulse voltage and the third to 80 per cent of that rated value. Grading of the levels at the station equipment will thus be greatly facilitated by the elimination of the previous uncertainty as to protective effectiveness under impulse conditions. The certain result will be that service reliability and avoidance of apparatus failure will be more economically attained than has been generally possible in the past. Work is still to be done, however, on negative waves and on steeper waves. In addition, economy dictates the ultimate elimination of one or more of the three insulation levels.

POLITICS

The resurrection of the Thayer letters from the files of the Federal Trade Commission has thrown the Lehman utility bills into the political forum. Their use for political purposes has gone far to undo the constructive testimony that showed the unfair features of the bills and has brought the pressure of anti-utility politics to bear upon the Legislature. These 1927 letters have nothing to do with the merits of the proposed legislation, yet they are used as the levers to force its acceptance. What about the 5 per cent return upon investment? What about the proposal to permit municipalities to build competing distribution systems without offering a fair price for the private utility systems? Why should the Thayer incident distract legislative attention from an intelligent consideration of these unfair features in the Lehman bills? But such is politics.

No electrical industry man condones any unethical relations that may have existed between Senator Thayer and the Associated Gas & Electric Company. The facts in this case are yet to be made available, however, and it must also be granted that some utility practices in 1927 are not those of 1934. This incident of the past should not be the agency to force unfair and confiscatory legislation upon the utilities of New York State.

Electric Annealing Slashes Strip Steel Rolling Costs

In a pioneering installation electric furnaces save $1.87 per ton in high-carbon steel treating over oil-fired equipment and $2.66 for low-carbon strip.

Electric annealing cycle 35 per cent faster and the quality is found to be superior to that obtained with competitive fuels.

By P. N. RUGG

Electric Heating Division, Boston Edison Company

IN 1929 the Thompson Wire Company, Mattapan, Mass., contemplated making an addition to its existing building for a new annealing department. This company cold-rolls and anneals high- and low-carbon strip steel for use in the shoe and automotive industries and in miscellaneous press work. The strip widths are from 1 to 6 in. Through the efforts of the electric heating engineers of the Boston Edison Company the Thompson company investigated electric furnace annealing equipment and installed bell-type furnaces in preference to oil-fired or gas-fired equipment. At first one electric furnace was installed, then two more, and recently a fourth was installed. The major factors entering into the decision to use electric heat were:

1. With the electric furnace there is a minimum of dead-weight material to heat in the furnace, so that a much shorter annealing cycle can be used.

2. Shorter annealing cycle, insuring quicker deliveries to customers—an important factor in present-day business conditions.

3. The furnace size is such that large or small orders can be readily and efficiently annealed; having several furnaces makes a very flexible set-up in this respect.

4. Each charge is uniformly annealed, due to the heat distribution in the furnace chamber.

5. A better-annealed and better-looking product, due to the close temperature control of the cycle.

6. Cleaner, cooler and quieter working conditions in annealing room. No chips, scale, borings, heavy pots or products of combustion present.

7. Lower over-all annealing costs.

The equipment with each furnace consists of the bell-type furnace proper, five car bases, five protective hoods, furnace guides, car rails, automatic temperature controls and contactors. The artificial atmosphere is obtained either by means of a 10-kw. city gas purifier or a 10-kw. ammonia dissociator, as both these equipments are installed. Usually purified city gas is used. A general

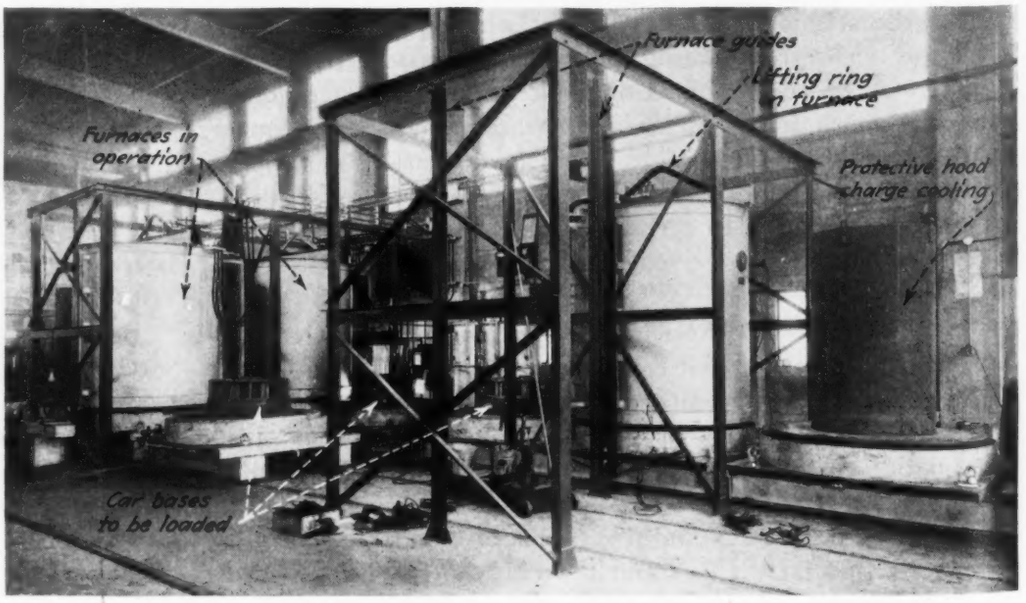


Fig. 1—General view of electric annealing room, showing three furnaces in operation, three car bases for holding charges and furnace guides for four units

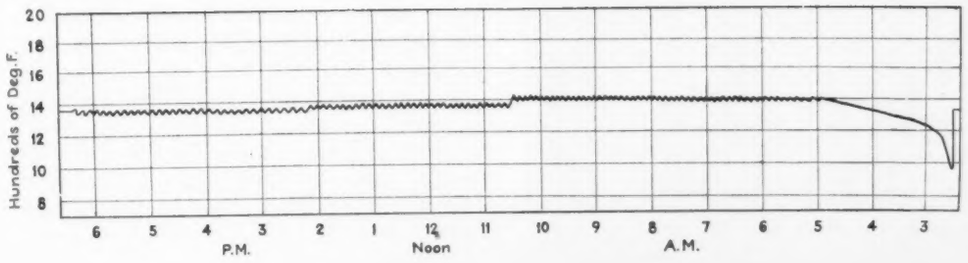


Fig. 2—Time-temperature curve showing accuracy of control during several hours in annealing cycle

Fig. 3—Partially charged car bases with gas-purifying tanks at rear

view of the annealing room is given in Fig. 1. This shows three furnaces installed, the vertical furnace guides, car bases and one car with a protective hood.

Operating cycles well controlled

The operating procedure is as follows: A charge of coiled strip is stacked on one of the cars and a protective hood is lowered over the charge. The pipe line for admitting the gas under the hood is connected to the inlet pipe on the car, the gas is admitted and the atmosphere under the hood is thoroughly purged. Exhaust gas from the hood is then lighted and burns continuously during the heating part of the cycle. After purging, the car is spotted under the raised furnace, which is then lowered by crane over the load, the electric circuit is closed and the annealing process begins.

For annealing "basic," or low-carbon, steel a typical heat cycle consists of raising the charge to about 1,400 deg. F., the time consumed while the charge is under the furnace being around eight hours. A high-carbon charge requires from 18 to 22 hours for heating and soaking. The accompanying time-temperature curve, Fig. 2, shows such a cycle and the accuracy of control that is maintained within the furnace.

At the end of the heating period the furnace is raised, the charge moved one car-length away from the furnace and a new charge whose car is coupled to this No. 1 car is brought under the furnace, which is again lowered and the annealing cycle again started. No. 1 car remains coupled to the train and the charge with the hood still over it cools at its natural rate. At the end of each cycle the entire train moves forward one car-length to allow a new charge to be annealed. When the charge on No. 1 car has cooled to the desired temperature the hood is removed and the coiled strip unloaded. No. 1 car is then carried by a crane hoist back to the starting position in front of the furnace, ready for a new load. A winch, operated by an 8-hp. motor, is used to move the train of cars. While the charge is cooling at its natural rate the discharge pipe for exhausting the artificial atmosphere is closed and the gas is held under the hood at a pressure. All loads are purged before spotting under the furnace. Natural cooling requires around 36 hours.

Two cars partially loaded before being covered with hoods and charged into the furnaces are shown in Fig. 3. The gas-purifying equipment is in the rear. Fig. 4 illustrates better the arrangement of car-trains on the discharge side of the two furnaces shown.

The furnaces, rated at 90 kw., 230 volts, three phase each, were supplied by the General Electric Company and take a charge of about 5 tons each, the coils being rolled to an outside diameter of 3 ft. and stacked about 4.5 ft. high. Each protective hood is provided with an apron that extends over the refractory car base and into an oil seal extending around the base (Fig. 4), so that an air-tight chamber is obtained. The hoods are of alloy steel, No. 12 gage, that will stand the high temperatures without warping. All seams and points of the hoods are arc-welded.

By having five car bases and hoods with each furnace the furnaces are in continuous operation 24 hours a day, except when changing loads, the cooling charges being moved out of the way, as mentioned above. Only about five minutes is required to raise the furnace, change the cars and lower the furnace, so the furnaces are operated at high efficiencies.

Nickel-chromium ribbon is used for the heating units, being so distributed about the inner cylindrical wall of the furnace that the charges are uniformly heated throughout. A center heating unit is suspended from the top of the furnace and extends down into the centers of the coils. In this way the charges are heated from the inside out, as well as from the outside in. In all cases the heat is transmitted from the units through the protective hoods to the charge.

Each furnace is equipped with two-point control; that is, there is a recording-controlling pyrometer to control

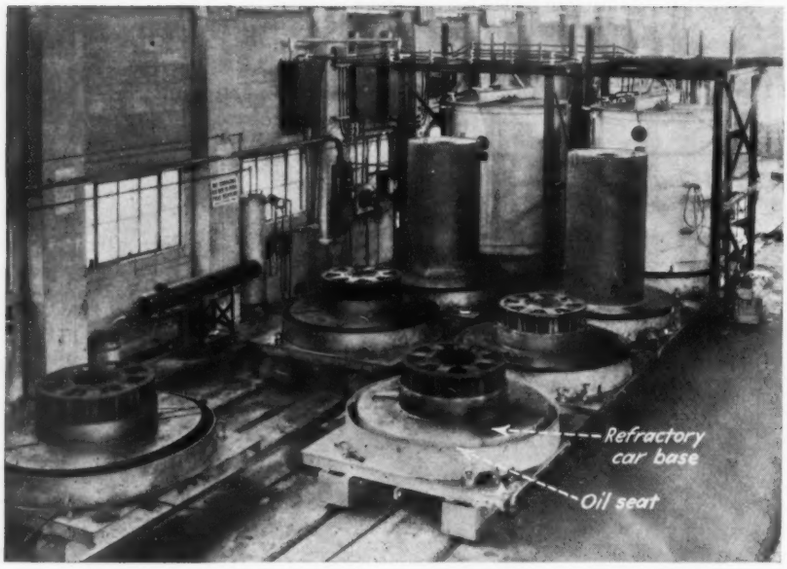


Fig. 4—Electric annealing room showing discharge sides of two furnaces and movable car bases

each of two groups of resistance units. One group includes the suspended central heating unit. With this control the furnace input is either 90 kw. (full capacity), 60 kw. or 30 kw., depending upon the temperature conditions within. The pyrometers were supplied by the Brown Instrument Company.

140 to 210 kw.-hr. per ton

With this equipment the Thompson company has been obtaining uniformly annealed strip that complies with its required hardness and bending tests, has a bright finish, is unoxidized and, in the case of high-carbon strip, has no surface decarburization. Records maintained on the operation of these furnaces show that an economy of 140 kw.-hr. per ton of basic annealed is obtained, and for high-carbon strip this figure is 210 kw.-hr. per ton annealed. These values include whatever furnace preheating is necessary and the energy consumption of the 10-kw. gas purifier, which averages 4 kw.-hr. per hour. Purified city gas used for the artificial atmosphere amounts to 160 cu.ft. per ton of strip annealed, which, with city gas at 80 cents per thousand, is 12.8 cents per ton.

Quality products obtained

In annealing high-carbon strip four major qualifications had to be satisfied. These were: (1) Refined grain structure; (2) no decarburization of the surface of the steel; (3) suitable (bright) surface appearance of the strip; (4) steel to be uniformly soft enough to pass the longitudinal folding test.

The longitudinal folding test consisted of taking a short sample of the annealed strip, say 2 in. to 4 in. long, and folding this strip on its longitudinal center line so that the two outer edges meet. The piece is then put in a vise and the surfaces squeezed together so that there is a surface contact the entire distance from the edges of the strip to the folded edge. To pass this test there must be no signs of cracking or fiber failure along the folded edge. This is a real test to determine whether or not the piece is properly annealed.

The absence of surface decarburizing, or softening, is apparent by taking Rockwell hardness measurements throughout an annealed coil or by laboratory tests. Rockwell hardness tests also checked the surface conditions for further carburization and uniform annealing. The desired maximum limit on the Rockwell B scale with a $\frac{1}{16}$-in. steel ball is 85. Table I shows the results of hardness tests for a charge annealed in the electric furnace. The steel was 0.80 carbon.

Flexible substation design

In planning the layout of the annealing room provision was made for the installation of six electric furnaces, providing electric annealing was satisfactory. Ninety-kilowatt furnaces of long-hour use, plus the motor and lighting load in the mill, warranted the Thompson Wire Company's becoming an Edison high-tension customer, the metering being on the primary side

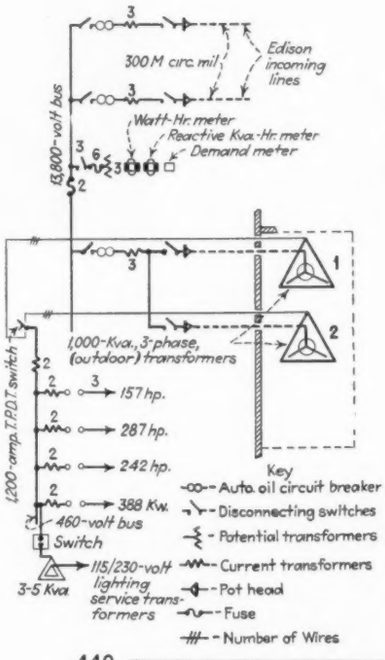


Fig. 5—Flexible substation design enables load to be carried on either or both of two incoming feeders and on either transformer

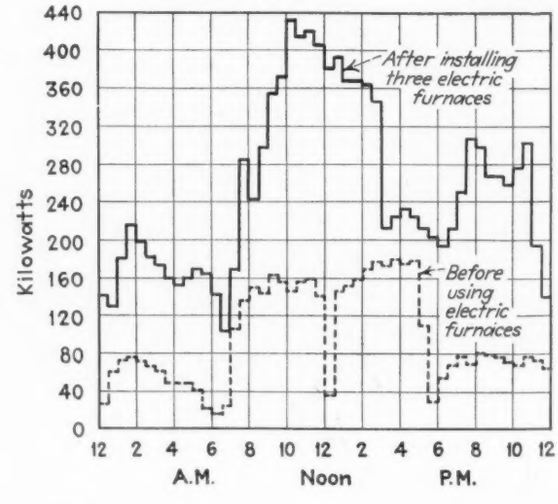


Fig. 6—Typical daily load curve of plant showing increased usage in valley and day hours resulting from electric furnace installation

Table I—Rockwell Hardness Tests on 0.80 Carbon Strip Annealed in the Electric Furnace

Coil No.	Inside End of Coil	Outside End of Coil	Per Cent Under Maximum Limit of 85 — Inside	Per Cent Under Maximum Limit of 85 — Outside
1	81.0	83.0	4.70	2.35
5	81.0	81.5	5.88	4.12
10	82.0	79.0	3.54	7.06
15	82.5	83.0	2.94	2.36
19	82.0	85.0	3.54	0.00
Av.	81.7	82.3	3.89	3.18

NOTE—Coil No. means the number of coils, from the top down, of a stack as loaded on the car base.

Table II—Comparative Over-All Costs of High-Carbon Strip

	Annealing Method — Electric Bell-Type Cost per Ton	Annealing Method — Oil-Using Pots Cost per Ton
Depreciation	$0.44	$0.33
Interest and taxes	0.32	0.26
Labor	0.60	1.38
Pot replacements	....	0.80
Chips and borings	....	0.03
Maintenance	0.03	0.09
Gas for atmosphere	0.128	....
*Electric energy at 1 cent per kw.-hr.	2.10	....
†Oil at 6½ cents per gallon	....	2.82
Protective hoods	0.22	....
Total	$3.838	$5.71

Saving per ton by electric equipment = $1.87—for high carbon.

*Includes energy cost for gas purifier and winch motor.

†Includes storage, pumping and atomizing costs and interest on investment.

of the transformer. Accordingly the company built a substation to the Edison company's specifications at the approximate load center of the mill. Duplicate 13,800-volt lines were brought in underground to the substation through the primary switching and metering equipment and then to two 1,000-kva. General Electric three-phase transformers located outdoors on the transformer mat. The wiring arrangement is shown diagrammatically in Fig. 5, which also indicates the load on each circuit. It may be seen that the load may be readily switched from one transformer to another and that either transformer can be used with either primary line. This gives complete flexibility to prevent possible plant shut-down due to transformer or service trouble.

There are four panels on the secondary side, one for each of the four circuits leading from the 460-volt bus. Each panel has an indicating ammeter of the proper scale, and there is also a watt-hour meter on the furnace main.

It is interesting to note that with this layout the furnaces use between 56 and 62 per cent of the total energy consumed in the plant.

As the furnaces are designed to operate on 230 volts and the secondary bus is run at 460 volts it was necessary to step down the voltage by a 2/1, 100-kva., three-phase transformer for each furnace. Switching and control of each furnace is at 230 volts.

Typical daily load curves (Fig. 6) give an interesting comparison of the plant requirements before and after the installation of the electric furnaces. The solid line curve gives the half-hourly demands with three furnaces in use, the metering being on the primary side of the 1,000-kva. transformers, and the other curve shows the plant requirements before any electric furnaces were installed, the metering being on the secondary side of the transformers supplying this customer. It is noteworthy how the night-time operation of the furnaces fills in to an appreciable extent the valley of the curve.

Oil-fired equipment less efficient than electrical

The previous equipment used for annealing the strip was oil-fired and consisted of two car-type furnaces of five pots capacity each and two car-type furnaces of three pots capacity each. The coils were stacked in the pots and packed with chips and borings; the pots were placed on the cars, which were then pushed into the furnaces, and the annealing cycle started. Each pot weighed 2 tons and cost about $240. Twenty-four pots were replaced annually. The chips and borings used to pack around the coils had a net cost of $6 per ton; about 10 tons was used each month. Maintenance on the oil-fired furnaces was between $500 and $600 annually for each furnace, with an average furnace life of twelve years.

Interesting comparative over-all costs between electric and oil furnaces are given in Table II. With this electric equipment a saving per ton of $1.87 for high-carbon steel is realized over using the oil-fired equipment. For annealing low-carbon steel the saving amounts to $2.66 per ton, and the annealing cycle, including cooling, is about 35 per cent quicker than the previous method. For high carbon the annealing cycle is about 25 per cent faster. The economy obtained with the oil furnaces was around 43.4 gal. of oil per ton annealed. New oil-fired furnaces similar to the four car-type furnaces would have cost $40,000 and the four bell-type electric furnaces cost $62,000, but the economies obtained with the electric annealing furnaces are such that the additional investment of $22,000 was warranted. It is expected that this equipment will pay for itself within four years.

The Thompson Wire Company is one of the first to use electric bell-type furnaces for annealing cold-rolled strip steel and may be considered a pioneer in the field among those using modern annealing methods.

Power Sales Opportunities

Present conditions contain many factors which tend to intensify the power salesman's argument. First, changing conditions and uncertainty as to the future and need of absolute economy in capital expenditures give great strength to our argument for small investments, as with purchased power instead of the private plant, and emphasize our plea for the advantages of flexibility. In the second place, prospective increase in fuel cost is a present-day condition which plays directly into our hands. Third, the executive faced with the imperative necessity of efficient operation of his own particular business will be less inclined to try to run a power plant and more interested in concentrating on the running of his own business, leaving the supply of power to the utility whose specialty power is.

FORD BATES,
Nebraska Power Company.

Mr. Bates so addressed power salesmen at the recent Engineering Conference of the Missouri Valley Electric Association.

A Five-Year

Ranges have not sold because women as yet have no real desire for electric cooking. Demand can only be created by long-term promotion that follows a consistent plan.

E.E.I. committee sets up such a program, based on a hypothetical city, to attain a range saturation of 25 per cent in five years.

POWER companies have been selling electric ranges for more than twenty years. So far somewhere around a million have been put into service, a saturation of about 5 per cent. It has been a long, uphill job, with little evidence of progress at any time. What is the reason?

Pierre L. Miles, chairman of the electric range section of the National Electrical Manufacturers Association, frankly discussed the problem before the recent conference of power company sales managers held in Chicago by the Edison Electric Institute sales committee. In this twenty years of unsuccessful selling, he said, a long series of merchandising ideas have been used by the utilities to stimulate the market for electric ranges. Each one has attempted to arouse the interest of the domestic customers by offering some special inducement. These ideas have received wide attention among power company men and been tried out in city after city, sometimes for years. There have been thirteen such sales ideas applied to ranges. For, at one time or another, it has been believed that the key to selling electric cooking was:

1. Cheaper electric ranges.
2. Lower rates for current.
3. Free or allowance for wiring (installation).
4. Free service.
5. Attain dealer co-operation in some form.
6. Special employee offers—or tips for leads.
7. Bonus or prizes for salesmen's efforts.
8. Increased salesmen's commission.
9. Longer terms of payment.
10. Smaller down payments.
11. Allowances for old fuel ranges.
12. Premiums to induce customer to buy.
13. A rental or trial plan.

Sometimes these ideas have been tried singly, sometimes in combination. But still ranges did not sell in satisfactory volume, and the reason was because one fundamental fact was overlooked—few women really want electric cookery today and none of the thirteen ideas is designed to make the ultimate consumer desire electric cookery. None of the thirteen ideas is designed to make her dissatisfied with her present cooking equipment.

Fundamentally, the problem is not how to sell ranges, but how to build up interest and confidence among women in the advantage of cooking by electricity. It is primarily an educational job, not a sales job. For the selling of the range must wait in every case until the woman begins to desire to cook electrically. Then comes the question of which range she should buy and what it costs and how she is to pay for it. The actual selling of the appliance itself does not start until then.

But they don't want to buy

THIS educational effort the industry has never yet seriously undertaken, and it stands today in the position of a company attempting to sell an airplane to a man who refuses to fly. The salesman may offer a low price, easy terms, cheap gasoline, free service and even throw in a hangar without charge, but the man is still afraid to fly. He doesn't want an airplane under any conditions, even if it is given to him.

The issue before the power industry today, therefore, is the simple question of whether or not the utilities are willing to undertake seriously the development of public demand. If so, it will require a well-planned, consistently developed program of advertising, demonstration and selling, carried on over a term of years. Mr. Miles presented an analysis of such a program as applied to a hypothetical city and the results which may be expected from a balanced sales operation. He assumed the conditions approximately that now exist in the city of Knoxville, which are:

Population of community served	100,000
Residential customers (4.5 people per home)	22,000
Present range saturation, 5 per cent	1,100
Potential market — prospects for electric cooking	20,900
Electric cookery rate, per kw.-hr. (or less), cents	3
Gas rate, per thousand cu.ft. (or more), cents	85
Communities scattered — partly rural —	.....
Saturation to be attained during five-year period, per cent	25
Objective — total system saturation, per cent	30

Under these conditions, he set up a quota of ranges to be sold based on a sustained advertising and sales effort to be carried on throughout the entire year for a period of five years and forecast the results that should be expected on a conservative estimate grounded on the actual experience of utilities under comparable conditions. This quota calls for the sale of 5,000 ranges within the five years and a resultant range saturation of 30 per cent (see Table I).

No allowance is made for the increase in number of domestic customers during this period, which would be

Table I—Quotas

Year	Quota Ranges	Per Cent Increase Over Previous Year	Per Cent of Potential Market	Resultant Range Saturation, Per Cent
End 1933	1,100	..	5	5
1934	400	..	2	7
1935	600	50	3	10
1936	900	50	4.5	14.5
1937	1,300	44.5	6.5	21
1938	1,800	38.5	9	30
Total sales, five-year period	5,000	..	25	30

Table II—Increased Kilowatt-Hour Revenue, Cumulative

Year	Yearly Range Sales	Cumulative Ranges Sold	Cumulative Kilowatt-Hours for Year Connected	Rate of Yearly Revenue Connected
1934	400	400	600,000	*$18,000
1935	600	1,000	1,500,000	45,000
1936	900	1,900	2,850,000	85,500
1937	1,300	3,200	4,800,000	144,000
1938	1,800	5,000	7,500,000	225,000
Total	5,000	.....	17,250,000	$517,500

*Based on half year's use of total number of ranges sold.

Range-Load-Building Program

Electric range section of N.E.M.A. presents a plan that was prepared by Pierre L. Miles, chairman

estimated as 2,000 homes. The saturation called for under this quota is not impossible of accomplishment. It has already been done, as witness the present saturation figures of:

	Per Cent		Per Cent
Winnipeg, Canada	58.5	Cal.-Oregon Power	31.7
Idaho Power properties	47.1	Washington Water Power	29.9
Seattle	34.2		

The sale of these 5,000 ranges on this schedule would result in an increase of 17,250,000 kw.-hr. in the period, producing $517,500 in revenue, based on 1,500 kw.-hr. per year per range at a 3-cent rate per kilowatt-hour (see Table II).

The estimated kilowatt-hours for all domestic customers in 1933 is estimated at 14,190,000, to which the added range load will have contributed 7,500,000 kw.-hr. annually, after the five years. This equals a 53 per cent increase in kilowatt-hours sold.

Starting with an assumed present rate of 5.7 cents per kilowatt-hour and with no change in the present rate schedules, the effect of this five-year program on the average rate for the domestic customers would be as follows:

	Cents per Kw.-Hr.		Cents per Kw.-Hr.
1934	5.55	1937	5.00
1935	5.4	1938	4.8
1936	5.25		

The reduction in this average domestic rate at the end of this period would be 15.8 per cent. At the same time it would increase the average kilowatt-hour consumption per domestic customer from the national average, assumed as the present local average, to 940 kw.-hr. (see Table III). This would be an increase in kilowatt-hour consumption per domestic customer of 57 per cent, with no allowance made for any normal increase of the lighting or appliance load.

At the average price of $126 over this period, gross sales over the period would total $632,500, which at an average discount of 43 per cent would show a gross profit of $271,000 (see Table IV). This does not include any wiring cost. The discount is based on carload prices at 40-5 per cent. To achieve this volume of sales it would be necessary to capture public attention for electric cooking and sustain the interest of the household twelve months in the year. This would call for an advertising expenditure of $125,000, or $25 per range sold, which would be 19.8 per cent of the sales billed (see Table V). The advertising program would embrace 156 40-in. newspaper ads and twenty billboards in continuous use, as well as demonstrations, window displays, direct-by-mail material, daily radio announcements and other miscellaneous activities necessary for a balanced advertising campaign.

This advertising should be supported with a force of from ten to sixteen specialty salesmen, which would entail an expenditure of $124,200 over the period, or 19.5 per cent of the sales billed, figured on the basis of an income to each salesman of $1,800 a year per man (see Table VI). This would provide a sustained effort

Table III—Effect on Kilowatt-Hours per Residential Customer

Year	Range Sales	Kw.-Hr. per Residential Customer	Year	Range Sales	Kw.-Hr. per Residential Customer
1933—Assumed	....	600	1936	900	730
1934	400	630	1937	1,300	820
1935	600	670	1938	1,800	940

Table IV—Gross Merchandising Sales and Profits

Year	No. Ranges	Ave. Price	Total Sales	Margin or Per Cent Discount	Gross Profit
1934	400	$140.00	$56,000	43	$24,000
1935	600	135.00	81,000	43	34,800
1936	900	130.00	117,000	43	50,300
1937	1300	125.00	162,500	43	69,800
1938	1800	120.00	216,000	43	92,800
Total	5000	$126.00	$632,500		$271,700

Table V—Advertising Expense

Year	No. Ranges	Total Advertising	Average per Range	Reduction Advertising Expense, Per Cent	Per Cent of Sales Billed
1934	400	$25,000	$63.50	..	45
1935	600	25,000	41.70	34	34
1936	900	25,000	27.80	33	21.3
1937	1,300	25,000	19.25	31	15.4
1938	1,800	25,000	13.85	28	11.5
Total	5,000	$125,000	$25.00		19.8

Table VI—Specialty Range Salesmen

Year	Number Ranges Sold	Number Specialty Men Necessary	Range Sales per Man per Year	Direct Sales Expense	Per Cent of Sales Billed	Per Cent Reduction Sales Expense
1934	400	10	40	$18,000	32	..
1935	600	12	50	21,600	37	15
1936	900	15	60	27,000	23	15
1937	1,300	16	82	28,800	18	21
1938	1,800	16	112	28,800	13	28
Total	5,000			$124,200	19.5	

throughout the year to capitalize on the advertising program. These salesmen, in turn, should be supported by two to four home economists to handle home service, store demonstrations, conduct cooking schools and help train salesmen. At an estimated selling and expenses of $1,500 a year each, this activity would add a further expense of $25,500, or 4 per cent on gross sales billed (see Table VII).

The total direct sales expense for advertising, salesmen and home economists would equal $274,700, or 43.4 per cent of the gross sales (see Table VIII). No overhead is included in this figure. The direct expense on the five years activity would therefore show an excess of $3,000 on the gross profits (see Table IX).

To this, of course, an overhead charge must be added, which is figured at 15 per cent on the 1934 sales of 400 ranges, and is gradually reduced to 10 per cent on the 1938 sales of 1,800 ranges. It produces a total cost for obtaining the business of $81,500, or $16.30 per range (see Table X). This overhead is calculated to cover all general expense and includes salaries, bonuses and expenses of sales supervisors, rent, light, heat and power, accounting and collections due to merchandise sold, uncollectible bills, insurance and taxes, interest on inventory, delivery to customers, servicing and miscellaneous. This total cost of obtaining the business, deducted from the income for additional load connected, would leave a profit for the operation of $436,000 (see Table XI).

The cost per dollar of annual gross revenue connected on the entire program equals 36 cents (see Table XII). The capital investment required for such a program, to cover the additional costs of generating station, primary and secondary distribution, as well as the cost of inside wiring, in the event that the company installs range wiring free and capitalizes this expense, can be calculated by any utility to arrive at the final net figures on such an operation under its specific local conditions.

The prime requisite for such a program is the courage to invest the money necessary to create this market. And this is the only barrier that stands in the way of any power company that wants to increase its revenue and earnings from domestic customers through improvement of its load factors, and is willing to work for it. There are other and additional results, however, that will accrue from such a five-year program of range development that are not shown in the figures, yet are of great importance. Mr. Miles listed them under eight heads:

1. Some utilities are of the opinion that the advertising expense, which is non-product advertising and deals entirely with the selling of the *idea* of electric cookery, can rightfully be charged to capital expense, rather than to the merchandising account. If this be done, it betters materially the showing made in the foregoing analysis.

2. With the advent of definite consumer acceptance of electric cookery, electrical and non-electrical retailers will sell electric ranges.

3. During the fourth and fifth years both the advertising and sales expense of the utility may be substantially decreased, the amount depending upon the extent to which other retailers take over these functions of merchandising.

4. With the created consumer demand, in favor of electric cookery, the market, among rented homes, will be opened up during the fourth and fifth year of the campaign.

5. This same principle applies to the apartment houses, wherever they are located.

Table VII—Home Economists

Year	Range Sales	Number of Home Economists	Estimated Cost	Per Cent to Gross Sales Billed
1934	400	2	$3,000	5.4
1935	600	3	4,500	5.5
1936	900	4	6,000	5.1
1937	1,300	4	6,000	3.7
1938	1,800	4	6,000	2.8
Total	5,000		$25,500	4

Table VIII—Direct Sales Expense

Year	Advertising	Salesmen	Home Economists	Total	Per Cent Sales Billed
1934	$25,000	$18,000	$3,000	$46,000	82
1935	25,000	21,600	4,500	51,100	63
1936	25,000	27,000	6,000	58,000	49
1937	25,000	28,800	6,000	59,800	37
1938	25,000	28,800	6,000	59,800	28
Total	$125,000	$124,200	$25,500	$274,700	43.3
Per cent of sales billed.	19.8	19.5	4	43.3	

Table IX—Billings and Direct Expense

Year	Sales Billed	Gross Profits	Direct Sales Expense	Profit or Loss	Cumulative
1934	$56,000	$24,000	$46,000	— $22,000	— $22,000
1935	81,000	34,800	51,100	— 16,300	— 38,300
1936	117,000	50,300	58,000	— 7,700	— 46,000
1937	162,500	69,800	59,800	+ 10,000	— 36,000
1938	216,000	92,800	59,800	+ 33,000	— 3,000
Total	$632,500	$271,700	$274,700		— $3,000

Table X—Direct Expense Plus Overhead

Year	Range Sales	Profit Loss (Direct Sales)	Per Cent Overhead Sales Billed	Dollars Overhead	Total Cost Obtaining Business	Cost per Range Sold	Per Cent Sales Billed
1934	400	—$22,000	15	$8,400	—$30,400	—$75.00	54.5
1935	600	— 16,300	14	13,300	— 29,600	— 49.50	36.6
1936	900	— 7,700	13	15,700	— 23,400	— 26.00	20
1937	1,300	+ 10,000	12	19,500	— 9,500	— 7.30	5.7
1938	1,800	+ 33,000	10	21,600	+ 11,400	+ 6.35	2.9
Total	5,000	— $3,000	12.4	$78,500	—$81,500	$16.30	

Table XI—Final Profit

Year	Range Sales	Merchandising Profit and Loss	Kw.-Hr. Revenue Connected	Kw.-Hr. Revenue Connected Plus Merchandise Revenue
1934	400	—$30,400	$18,000	—$12,400
1935	600	— 29,600	45,000	+ 15,400
1936	900	— 23,400	85,500	+ 62,100
1937	1,300	— 9,500	144,000	+ 134,500
1938	1,800	+ 11,400	225,000	+ 236,400
Total	5,000	—$81,500	$517,500	+$436,000

Table XII—Cost per Dollar of Annual Gross Revenue Connected

Year	Ranges Sold	Merchandising Profit and Loss	Annual Gross Revenue Connected	Cost Per Dollar of Annual Gross Revenue Connected
1934	400	—$30,400	$18,000	$1.69
1935	600	— 29,600	27,000	1.10
1936	900	— 23,400	40,500	0.58
1937	1,300	— 9,500	58,500	0.16
1938	1,800	+ 11,400	81,000	+0.14
Average....	5,000	—$81,500	$225,000	$0.3

6. At the end of the five years definite consumer acceptance will be created for electric cookery and the business will carry on with the minimum of sales expense.

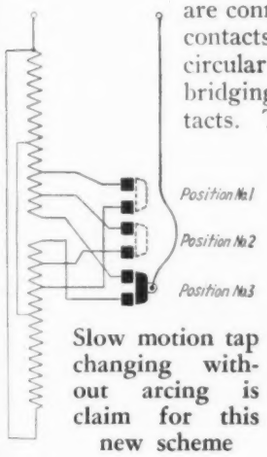
7. The groundwork will be laid for developing the water heating load, since it is quite essential, for the full development of water heating business, to have an electric range in the home.

8. Plus values will also be realized through the ranges sold by the dealers, both electrical and non-electrical, during the five-year period.

New Tap-Changing Plan Minimizes Contact Arcing

Feasible up to about 300 kva., three phase and up to a circuit voltage of 80 kv. is a new scheme for transformer tap changing under load. It is described in the February number of *Siemens Zeitschrift*.

Each phase consists of two halves, with the break in the middle of the stack. Three (or more) taps are placed at the two ends of the break; that is, at the middle of the stack. The resulting six tap leads are connected as shown to six stationary contacts, which may be arranged on a circular dial or along a straight line. A bridging finger can glide over these contacts. The finger is wide enough always to bridge two adjacent contacts. Nos. 1, 2 and 3 are operating positions. For three-phase Y-connection the three gliding fingers are electrically one solid piece. In the intermediate positions a circulating current will flow through the bridging finger, but its magnitude can be easily kept within safely permissible limits by choosing proper impedance in the tap sections. Even under short-circuit conditions these impedances can be so dimensioned that the tap sections offer thermally the same degree of safety as the remainder of the transformer winding.



Slow motion tap changing without arcing is claim for this new scheme

By thus using parts of the winding as current-limiting devices the use of unreliable resistors or expensive reactors is entirely obviated. This arrangement, furthermore, makes it unnecessary to accomplish the switch-over fast or with an involved snap action, because no harm is done if the sliding finger should stop at any point. A direct and relatively slow drive, such as, for example, by a spindle and a traveling nut, is perfectly satisfactory.

The amount of arcing is so slight that such a tap switch can be installed directly in the transformer tank. A cleaning or filtration of the oil may not be required until after some 100,000 operations of the switch, representing under normal circumstances a service of a decade of years.

As a rule, these switches are arranged for manual operation. If so desired, a remote and automatic motor operation can be provided. In this case, however, the cost of the switchgear and the operating mechanism may exceed the cost of the transformer proper.

E.E.I. and N.E.M.A. Agree on Insulation Yardsticks

Substantial progress has been made in insulation coordination. At Cleveland last week (ELECTRICAL WORLD, March 31, page 487) a joint committee of N.E.M.A. and E.E.I. announced that agreement had been reached as to impulse flashover values on rod gaps and insulator strings. The high-voltage laboratories agree to meet the specifications on the 1 by 5 and the 1.5 by 40 waves, the first figure denoting the time in microseconds from zero to crest voltage and the second denoting the time from zero to half value on the tail. The data are for positive waves only.

Table I—Impulse Voltage Flashover, Positive Wave

Suspension insulators, 10 in. diameter, 5¾ in. spacing.

Barometer 760 mm., temperature 25 deg. C., humidity 6.5 grains per cu.ft.

Data from General Electric, Locke, Ohio Brass and Westinghouse Laboratories averaged.

No. of Units	Minimum Flashover Kv. Values on Tails of Waves: 1x5 Micro-seconds	1½x40 Micro-seconds	No. of Units	Minimum Flashover Kv. Values on Tails of Waves: 1x5 Micro-seconds	1½x 40 Micro-seconds
3	390	355	12	1,355	1,105
4	500	440	13	1,460	1,185
5	610	525	14	1,565	1,265
6	715	610	15	1,670	1,345
7	820	695	16	1,775	1,425
8	930	780	17	1,880	1,505
9	1,040	860	18	1,985	1,585
10	1,145	945	19	2,090	1,665
11	1,250	1,025	20	2,200	1,745

Table II—Impulse Voltage Flashover, Positive Wave

Rod Gap

Barometer 760 mm., temperature 25 deg. C., humidity 6.5 grains per cu.ft.

Data from General Electric, Locke, Ohio Brass and Westinghouse Laboratories averaged

Spacing, Inches	Minimum Flashover Kv. Values on Tails of Waves: 1x5 Micro-seconds	1½x40 Micro-seconds	Spacing, Inches	Minimum Flashover Kv. Values on Tails of Waves: 1x5 Micro-seconds	1½x40 Micro-seconds
10*	240	190	60	1,230	945
20	440	350	70	1,425	1,095
30	640	505	80	1,620	1,240
40	835	650	90	1,815	1,385
50	1,035	800	100	2,010	1,530

*Values for 15-in. spacing and less may be subject to modification when more data are available.

These data afford yardsticks to determine insulation levels and work is under way to fix three levels for the nominal voltages of systems. One level is the rod gap, another the 80 per cent arrester level and a third the 100 per cent arrester level.

The rod gap is defined as one-half inch, square-cornered, square-cut rods coaxially spaced and overhanging their supports at least one-half the gap spacing and mounted on conventional insulators giving a height of 1.3 times the gap space plus 4 in. (plus 10 per cent tolerance) above the ground plane.

Network Protector Operations

By JOHN S. PARSONS and M. A. BOSTWICK

Distribution Engineering, East Pittsburgh — Relay Engineering Department, Newark
Westinghouse Electric & Manufacturing Company

Network protectors are often so sensitive as to operate more frequently than really is necessary. Excessive maintenance results.

Giving the protector an accessory which affords it an insensitive reverse-current setting greatly reduces the unnecessary operations and the resultant contact maintenance.

ON LOW-VOLTAGE a.c. network systems there are locations where the network protectors will operate oftener than is necessary for the correct functioning of the system if the usual sensitive reverse-current setting is used. This is particularly true of those systems where the network is fed from a number of different generating station or substation buses whose voltages are appreciably different in magnitude or phase position. These unnecessary protector operations are objectionable because eventually they will lead to excessive maintenance costs. Approximately half the network protectors sold during the last three years have been provided with control equipment which permits them to be given an insensitive reverse-current setting if necessary.

The sensitive network protector can be adjusted to trip on values of reverse current from zero to 2 or 3 per cent of the protector rating. Where a setting somewhat higher than this is needed it is only necessary to equip the three-phase network master relay with a stronger reverse-current spring. However, a relay equipped with a strong reverse-current spring should not be given a reverse-current setting in excess of 10 or 12 per cent of the protector rating, because if a higher setting is used there is a possibility that the protector may not trip to clear a primary fault. This method of obtaining a somewhat insensitive reverse-current setting is not very widely used, probably because there is usually a question as to whether a 10 per cent setting will prove to be high enough.

There are two general methods of obtaining insensitive reverse-current settings in excess of 10 per cent which have been used to a considerable extent for a number of years. They are the shunt reactor scheme and the voltage restraining scheme. An improved method of rendering network protectors insensitive has been developed which provides for adjustable high reverse-current settings under normal operating conditions by means of voltage restraint. It differs from other voltage restraining schemes, however, in that it provides for eliminating all restraint under fault conditions, thus rendering the protector sensitive and insuring more positive operation when a primary fault occurs.

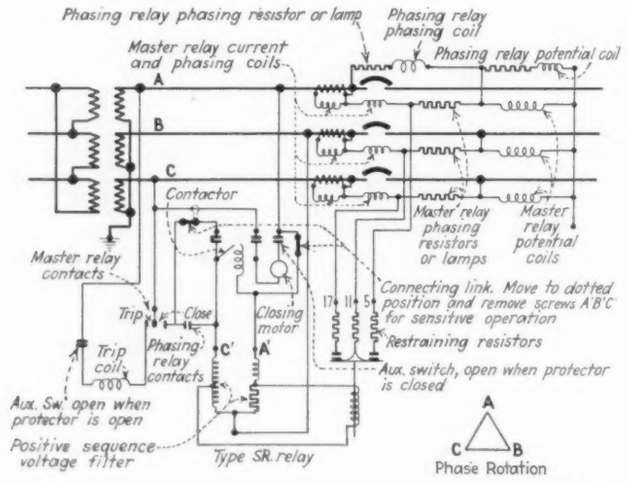


Fig. 1—Improved voltage restraining scheme obtains high reverse-current settings on network protectors

Operation of the improved scheme can best be described by referring to Fig. 1. A standard three-phase network master relay, the usual contactor for controlling the closing motor circuit, and a standard phasing relay, when necessary, are employed. In addition to these usual relays a simple voltage relay, a positive phase sequence voltage filter and three tapped resistors, all mounted in one case and known as the type SR relay, are used.

The master relay and phasing relay function in the usual manner to make their closing contacts. These two sets of contacts in series when closed energize the contactor and complete the energizing of the positive phase sequence voltage filter in the type SR voltage restraining relay. The type SR relay picks up and closes its contacts. This connects the phasing coils of the master relay together through the three resistors in the type SR relay. Appreciably more current now passes through the phasing coils at such an angle that these coils acting in conjunction with the potential coils produce a strong torque to maintain the master relay contacts closed. When the contactor closes, one set of its contacts energizes the closing motor of the protector. Its other set of contacts shunts the contacts of the phasing relay. This seals the contactor in the energized position through the master relay contacts. These contacts, of course, remain closed after the protector closes due to the restraining torque produced by the phasing and potential coils. The contacts of the phasing relay may or may not remain closed and it is, therefore, necessary to shunt them by the contactor contacts.

With the protector closed the phasing coils act as restraining coils and in conjunction with the potential coils produce a torque which must be overcome by the action of the current and potential coils. The amount of reverse current at normal voltage necessary to overcome the restraining torque and trip the network protector can be adjusted by changing taps on the resistors in the type SR relay, which varies the amount of current through the phasing coils.

When a fault occurs on any phase or phases which appreciably affects the system voltage at the protector

Reduced by Improved Control

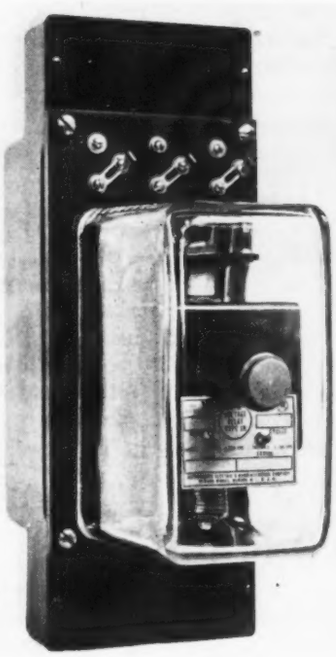
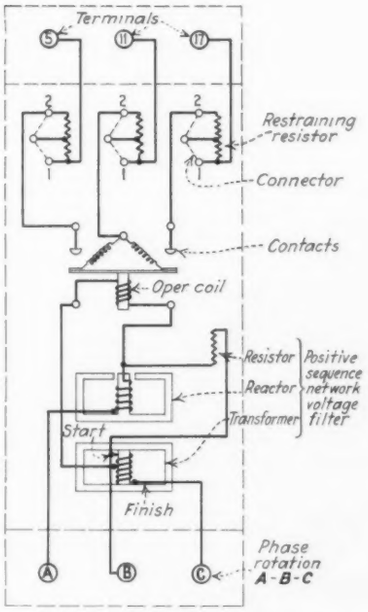


Fig. 2 — Type SR relay includes positive phase-sequence voltage filter, voltage relay and adjustable restraining resistors

The relay is set to pick up on about 95 per cent and drop out on about 90 per cent of normal positive sequence voltage.

Fig. 3—Reverse-current setting of the protector changed by changing amount of resistance in the restraining circuit

The relay may be set so that the protector will trip at normal voltage on an in-phase reversal of approximately 17, 25 or 35 per cent of the protector rating.



the positive phase sequence voltage at that point will be reduced. A reduction of about 10 per cent in the positive sequence voltage will cause the type SR relay to open its contacts and de-energize the phasing coils, thus reducing the restraining torque to zero and restoring the master relay to its sensitive condition. The network protector is now under the control of a sensitive directional relay which will operate quickly and positively to trip if the fault is so located as to cause a reversal of power through the protector.

It is desirable that a network control scheme be such that either a sensitive or an insensitive setting can be used. With this scheme the protector can be made sensitive to very small values of reverse current under normal conditions merely by moving the two connecting links *D* in Fig. 1 to the dotted positions and opening the connections to the phase sequence filter by removing screws *A'*, *B'* and *C'*. Now the closing of the contacts of the master relay and the phasing relay in series energizes only the contactor, which operates to energize the closing motor and to seal itself closed by shunting the master and phasing relay contacts. As the type SR relay is not energized the phasing coils are not connected to produce a restraining torque and the protector functions sensitively.

The most important advantage of this improved method of obtaining high reverse-current settings when compared with other voltage-restraining schemes is that its restraining torque is reduced to zero on any type of fault which causes an appreciable drop in voltage on any phase or phases, thus giving maximum reliability of operation. With other voltage-restraining schemes the restraining torque under most fault conditions is by no means zero.

No contacts in voltage transformer circuits

This scheme also has a number of advantages over the widely used shunt reactor scheme, which it is eventually expected to supersede. Probably the chief advantage is that no contacts are required to operate in the very low voltage current transformer circuits. Both in this improved scheme failure of the type SR relay contacts to make and in the shunt reactor scheme failure of the cut-out contacts to make, the protector is left

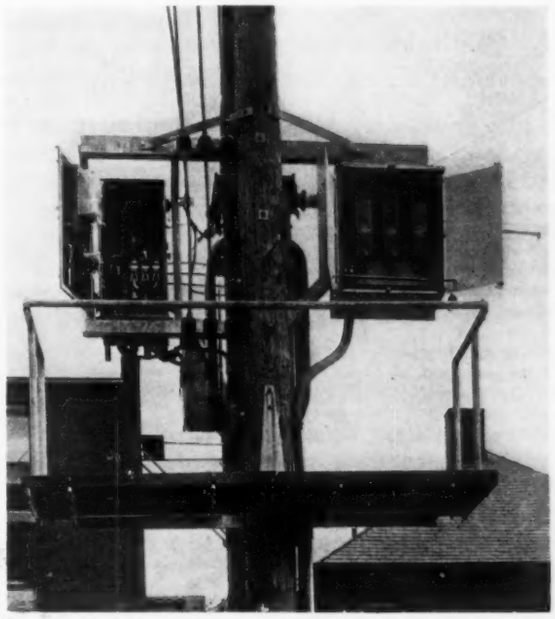


Fig. 4—A 45-kva. overhead secondary network installation on the Detroit Edison system

A 200-amp. type CM-4 overhead network protector is controlled by the type SR relay high reverse-current setting scheme. The type SR relay is mounted at the bottom of the door of the protector. Note how it compares in size with the network master relay mounted above it.

operating with a sensitive setting. However, such a failure of the SR relay contacts is much less likely because of the higher contact pressure which normally exists and because of the very much higher voltage of the circuit in which they are used. When using either scheme failure of the above-mentioned contacts to open leaves the protector operating with an insensitive setting. Under this condition, however, the action when a fault occurs is quite different. In the case of the shunt-reactor scheme the amount of reverse current required to trip increases as the voltage decreases, whereas with the improved voltage-restraining scheme the reverse current required to trip decreases as the voltage decreases, thus insuring more positive opening of the protector.

The closing characteristics of the protector when using the SR relay scheme are the same whether a sensitive or an insensitive setting is used. This is not true of the shunt reactor scheme as the connection of the reactors in parallel with the current coils of the network master relay changes the closing characteristics of this relay somewhat. This improved scheme should in most cases operate faster to trip the network protector than the shunt-reactor scheme because the master relay contact travel remains constant for any high reverse-current setting, whereas in the case of the shunt-reactor scheme increasing the reverse-current setting means increasing the contact travel and consequently the tripping time for any given value of torque.

In addition to the above-mentioned operating differences in the two schemes the fact that the additional equipment necessary to obtain insensitive settings is incorporated in the one small type SR relay gives a simpler and more easily maintained network protector than does the shunt-reactor scheme. Protectors equipped with this improved insensitive control scheme have been operating satisfactorily in service for more than a year.

Russian Electrical Plans

Envisioning the production of 38,000,000,000 kw.-hr. during 1937, or more than twice the amount generated in 1933, a recent issue of the Bulletin of Economic Information, published by the U.S.S.R. Chamber of Commerce, sees a notable expansion there. For comparison with other years the following production figures (in millions of kw.-hr.) are quoted from the same source: 1913, 1,940; 1928, 5,000; 1933, 15,800.

Small Utility Diesels in $0.0193 to $0.0843 Range

Diesel operating cost figures for ten small utility plants during 1932 have recently been released by George Charlesworth, electrical engineer of the Iowa Railroad Commission. These figures extend the 1931 figures presented by him at the tenth annual conference of utility commission engineers held in 1932. Ranging in load factors from 33.33 per cent (585-kva. plant No. 4) to 8 per cent (1,025-kva. peak-load plant No. 10) the costs per net kilowatt-hour range from $0.0193 to $0.0595. One plant (No.1) has a large margin of capacity over peak load and shows the high cost of $0.0843 cents per net kilowatt-hour.

Output Consumption and Costs for Utility Diesel Plants

Plant No.	1	2	3*	4	5	6	7	8	9	10
Size units in kva.	1-237; 1-75	1-300; 1-200 1-75	2-513	1-585	3-513; 1-250	3-600	2-512; 1-375	1-690	1-690	1-525; 1-300 1-200
Type	2c; SI	4c, AI; 2c, SI; 2c, SI	4c; AI	4c, AI	4c; AI; 2c, SI	2c, SI	4C, AI	2c, AI	2c, SI	2c, SI
Operation	Isolated	Isolated	.....	.....	Full Load only	†	Base Load	Peak Load	Peak Load	Peak Load
Total kw.-hr. generated	210,470	661,930	2,121,600	1,409,410	1,751,200	2,721,770	2,422,980	588,300	495,200	388,590
Kw.-hr. light and power	7,762	37,170	51,593	27,919	17,398	88,616	81,834	13,100	12,980	8,980
Kw.-hr. station losses	8,603	11,780	5,125	23,206	13,389	36,054	14,075	.....	.....	.....
Net kw.-hr. for use	194,105	612,198	2,064,882	1,358,285	1,720,413	2,597,100	2,327,071	575,200	482,220	379,610
Station capacity kva	309	575	1,026	585	1,789	1,800	1,399	690	690	1,025
Maximum demand kw.	75	250	920	480	1,700	.....	1,100	610	560	550
Fuel oil used, gallons	38,111	82,300	203,814	128,355	148,265	286,583	234,664	56,995	46,348	35,314
Cost of fuel oil	$1,382.59	$2,987.25	$7,569.45	$4,844.97	$5,846.63	$10,139.43	$8,789.38	$2,016.65	$1,628.33	$1,304.54
Cost of fuel oil f.o.b. plant	$0.036	$0.036	$0.037	$0.038	$0.039	$0.035	$0.037	$0.0353	$0.0351	$0.0369
Net kw.-hr. per gal. fuel oil	5.1	7.44	10.1	10.6	11.6	9.1	9.9	10.3	10.7	10.7
Gallons lubricating oil	1,122	1,544	1,483	701	1,519	3,276	2,319	420	403	428
Cost of lubricating oil	$0.527	$0.537	$0.526	$0.53	$0.508	$0.514	$0.514	$0.499	$0.65	$0.48
Net kw.-hr. per gal. lub. oil	173	397	1,392	1,938	1,133	793	1,004	1,400	1,197	887

Itemized Costs per Net Kilowatt-Hour

Int. at cost of money	$0.0274	$0.0163	$0.0070	$0.0062	$0.0132	$0.0092	$0.0078	$0.0126	$0.0142	$0.0277
Wear out on 20-year average life	0.0136	0.0080	0.0035	0.0031	0.0067	0.0045	0.0040	0.0062	0.0069	0.0133
Taxes	0.0093	0.0030	0.0016	0.0015	0.0003	0.0015	0.0002	0.0034	0.0043	0.0074
Fuel oil	0.0071	0.0049	0.0037	0.0036	0.0032	0.0039	0.0038	0.0035	0.0034	0.0034
Lubricating oil	0.0030	0.0015	0.0004	0.0003	0.0004	0.0006	0.0005	0.0004	0.0005	0.0005
Operating labor	0.0110	0.0050	0.0017	0.0031	0.0016	0.0013	0.0017	0.0020	0.0019	0.0038
Water	0.0001	0.0005	0.0002	0.0002	0.0001	0.0001	0.0001	.....	.....	.....
Maintenance	0.0121	0.0007	0.0010	0.0013	0.0008	0.0008	0.0011	0.0019	0.0018	0.0010
Insurance	.....	.....	.....	.....	.....	.....	.....	0.0010	0.0009	0.0020
Miscellaneous	0.0007	0.0005	0.0002	0.0005	0.0001	0.0005	0.0003	0.0002	0.0002	0.0004
Total power costs	$0.0843	$0.0404	$0.0193	$0.0198	$0.0264	$0.0224	$0.0195	$0.0312	$0.0341	$0.0595

*Has reserve capacity for No. 4. †As reserve for three transmission systems. Legend c = cycle; SI = solid injection; AI = air injection.

More Kilowatt-Hour Sales From Air Conditioning

By CHARLES E. MICHEL
Sales Manager, Union Electric Light & Power Company

Experience in St. Louis will now be capitalized by a broader program of market development as reported to the recent E.E.I. sales conference.

AIR CONDITIONING has arrived at the point where additional kilowatt-hour sales are proportional to the sales effort put forth. Space cooling presents the most important field and divides itself into three groups:

1. Cooling for comfort and health in residences and executive offices.
2. Cooling for profit in stores, restaurants, theaters and all those places where volume of business depends on attracting attendance.
3. Cooling for industrial processes.

These three fields vary in their attractiveness with different localities, but each is present in almost every section of the country.

The comfort and health market is one which lends itself to the wide distribution of comparatively small units which, once started, will progress at a rapid rate. Small units are necessary. Last year a limited number of such devices were on the market, and from the experience gained the manufacturers have developed self-containd units, in some cases made portable by being mounted on rubber-tired casters.

We know of at least five of the large manufacturers who have included this type of equipment in their lines in one or more sizes. At least one can be operated on a 115-volt circuit. These units, in most cases, have ½-hp. motors. The cost will be about $400. They will be capable of cooling and dehumidifying rooms of 150 to 200 sq.ft. under average conditions. Here is a piece of package merchandise which already has public acceptance because the results are tried and proven, are desired by the public and the price is right.

Without considering the many applications for residence and office cooling, on which installation work is required, we now have the opportunity of selling a package cooler which will bring us a revenue in kilowatt-hour sales comparable to the well-established domestic refrigerator. These self-contained room coolers will consume approximately 500 watts per hour. Data gathered recently by our air-conditioning subcommittee shows an average usage of cooling equipment in excess of 1,200 hours per season. The figures vary from 500 to 2,800 hours. We believe that most of the small self-contained room coolers will run at least 1,000 hours during the cooling season and we have for each one of these installations a potential increase of 500 kw.-hr. per season.

Manufacturers and distributors are alive to the importance of the market. They have gaged the market for 1934 and have geared their production to a substantial volume. As a result, the number of salesmen who will contact the public will be greatly increased over last year. Contacts with distributors in St. Louis lead us to believe that there will be more than one hundred salesmen in that territory, where there were but 30 last year.

This type of equipment will create a desire to possess larger and more adequate equipment. In 1932 a customer in St. Louis made an installation of three cabinet type room coolers connected to one refrigerating machine. In 1933 he added two more rooms. In 1933 another customer made an installation consisting of a 3-hp. machine and four room coolers. Only a few days ago we were called on to increase his service because he had purchased new equipment with a 7½-hp. compressor, which will enable him to cool seven rooms. In interviewing this customer we found that he was highly pleased with the installation of the previous year and is completely sold on the necessity of providing complete summer comfort for his home.

Summer service experience

IN COOLING for profit, change has taken place. In 1933 little thought was given to summer cooling and dehumidifying until the hot weather actually arrived. We have been advised by one distributor in St. Louis that on February 1 he had 46 proposals outstanding for summer cooling and dehumidifying in stores. Another told us that if he could close 15 per cent of the proposals which he had made he would consider that he had had a successful season. Distributors' salesmen and our own men report that it is no longer a question of convincing the retail store executive that he should have cooling and dehumidifying. The question now to be considered is what type of equipment is most applicable and what it will cost. The manager of a large specialty

shop stated to us the other day that he was surprised at the reasonable cost of the proposals which had been submitted to him. These men have learned that there is a new and useful tool available to them in attracting customers and keeping them in the store to purchase merchandise. Here is a tremendous field for the aggressive salesmen.

Another market in the air-conditioning field which has not been touched is the use of mechanically circulated air to increase the adaptability and usefulness of warm air heating. These mechanical warm air heating systems are now designed to heat and humidify the air in winter, to cool and dehumidify in summer, as well as to cleanse and circulate the air during all periods of the year. For the summer cooling and dehumidifying a compressor and the necessary cooling coils are added. The additional installation cost is comparatively small. Tests which have been conducted indicate that in the moderate size home from 300 to 400 kw.-hr. will be consumed during the year by the motor-driven fan. It will mean that we have in this device alone the possibility of increasing the energy consumption of the average residence by approximately 50 per cent. One St. Louis company, during a period when new residential construction was at low ebb, made 50 such installations. Another reported that during 1933 it had made 35 installations, all of these in new residences.

There are tens of thousands of gravity type air heating systems which can be converted into air-conditioning systems by the addition of a motor-driven fan, filters and humidifying equipment. It offers to us a tremendous potential market. It will give the owner improved heating, clean air, circulation and humidification. On many of these systems it will be possible to include, at a later date, summer cooling and dehumidification.

Industrial air conditioning is the parent of air conditioning for comfort. It has been established for many years, but, in turn, it has been given impetus by its offspring. Many new opportunities are developing for the application of air conditioning in industry as a result of experience with comfort cooling.

The St. Louis method

OUR plan for promotion of air conditioning in St. Louis is built around man power. We propose that the St. Louis Air-Conditioning Bureau bring together for a week's study and training 80 to 100 dealers and salesmen who will actually be in the field this summer. We intend to prove to these men that air conditioning has actually arrived and that there is a well-defined and growing market. We will convince them that a correct sales procedure will produce a definite volume of business. The men will then be trained in a simple but effective sales technique developed out of experience so that each man will be able to put over the air-conditioning idea in a sound, conclusive manner.

The first step will be the proper use of a "sales visualizer" to sell the prospect on the reasons for and the benefits to be derived from air conditioning. The second step will be to secure the prospect's attendance at a practical demonstration of air conditioning. The third step will be to uncover systematically the prospect's needs and requirements so as to be able to suggest to him just the right equipment for his purpose. The fourth step will be to concentrate enough personnel and mail follow up to close the sale. To support this plan we will again have a number of exhibits so that more and more people may be brought in contact with the benefits of room cooling and dehumidifying.

We believe that only the utility is in a position to make a complete and impartial display of all types of equipment and carry a demonstration of air conditioning direct to all the groups that can be interested. The value of a central exhibit and demonstration has been thoroughly proved. It provides a place where the prospect may investigate the subject with the maximum of help and information. It provides an impressive demonstration to the public that air conditioning is no longer a distant ideal, but an accomplished fact, requiring immediate consideration and decision.

Many exhibits planned

WE PROPOSE an exhibit in a hotel to place the air-conditioning idea before business organizations, hotel men themselves and the traveling public. An exhibit of room-cooling equipment in an apartment building, to which prospects will be brought by appointment, will also serve to show apartment owners and operators a new device for keeping their properties rented. A suite in an office building will also be air conditioned and building owners, managers and tenants will be brought in by special invitation. There will be an exhibit of self-contained, popular-priced units in a department store as well to emphasize that air conditioning is practical, that prices are down, that operating costs are right and that every one can now consider himself a prospective purchaser. In addition one of the model homes now being built by a realty company will be used for a demonstration of complete summer and winter residential air conditioning by a central plant.

The idea, of course, is not merely to put air conditioning on display at as many points as possible in the hope that the right people in each case will discover the equipment. Rather, we will use each display as a focusing point for a specific promotion whereby a selected group of prospects will be talked to in the particular language they understand and will be shown room-cooling equipment under the particular surroundings where they will use it.

We are planning a book of evidence as a supplement to the "sales visualizer" showing pictures of important installations, together with a brief statement of what these have accomplished for their owners. This is intended to pile up evidence of a specific character so that no reader can escape the conclusion that air conditioning is here in a big, impressive and final way. A booklet for general distribution will be provided showing the "A B C's of air conditioning," which will take the mystery out of the subject and will sell air conditioning as the next great improvement in living.

The position of Union Electric, with nothing to sell but service and with a distinct interest in helping each purchaser to secure the most satisfactory installation, will be made clear in a letter. This will be mailed to selected retailers, owners of apartments, office buildings, restaurants, hotels and other classifications of prospects, as well as to architects and engineers and others who influence the purchase of building improvements. We will provide the necessary follow-up material for each classification, in which the facts and arguments, specifically adapted to that classification, are concentrated.

We believe that newspaper advertising can and will

play an important part in reaching the prospect because we find him in unexpected places. We have excellent topics for such advertising. We can tell the people what they want to hear. We can tell them that room cooling and dehumidifying is now within the reach of their pocketbooks. We can tell them of the lower prices of equipment and simplified installations and of the low operating cost. We can tell them that the investment which they may make in room-cooling equipment is justified for improved health, the prevention of depressed and nervous conditions and for higher working efficiency. We can tell them of the many successful installations that have been made in the past. We can advise them that Union Electric is prepared to serve them and give complete information on the subject.

We believe that the market is ready and that product development has reached the point where organized manpower, carefully manned exhibits and aggressive advertising will result in volume sales of equipment and thereby in increased kilowatt-hour sales from air conditioning.

[Informal opinions on present conditions and problems confronting the industry are helpful. We welcome to this forum the type of discussion presented by Mr. Rae and hope others will discuss industry questions here in a similar constructive vein.—EDITORS.]

Frank B. Rae takes—

a realistic look at lighting sales and asks a new industry viewpoint

In all the "Better Light—Better Sight" activity so proudly and widely heralded the best light-selling jobs have been done by a hotel man, a newspaper man and a department store man. Electrical men, titular leaders of the lighting business, have been bringing up the rear, running after the bandwagon instead of riding on it.

These are harsh words. Intentionally so. For the lighting industry today has a tremendous and solemn opportunity laid in its lap, an opportunity to render incalculable service to the public to its own enormous profit. And all it seems to see in that opportunity is bigger bulbs and increased wattages and the hanging on the ceiling of additional jimcrack brassware.

In other words, the wonderful work of Luckiesh and Moss is reduced by the lighting industry to a mere matter of higher intensities. The phenomenal photronic cell gadget of Weston's engineers is reduced to a mere tape measure for lumens. The fundamental and dazzling opportunity behind these two developments, the opportunity to deal with light as desirable merchandise, smartly styled, tailored to individual needs and tastes, has apparently been lost upon an industry wholly and sordidly intent upon the price tags on portables and the discount schedules of fixture manufacturers.

That ol' debil price again

The experience of the lighting sales activity, however, reveals that the public which buys the equipment and pays the light bills is only moderately interested in prices and discounts. It sees in this "new approach" movement an answer to an unsatisfied desire. The public wants better light.

It has been the industry's habit and pleasure to damn the fixture and portable manufacturers for this condition. But the sad fact is that the fixture manufacturers and the portable manufacturers make what we buy—if we didn't buy it they wouldn't make it. And they make it as cheap as they can because we demand to buy it cheap—they'd gladly make better stuff for us if we would remove the chisels from the purchasing agents' desks. And as for the design of the atrocities they make, who ever said to a fixture manufacturer, "Listen my friend, go throw that plumber who calls himself your designer out on his ear and hire yourself a *real* designer, some one who can think in terms of lighting effects instead of in terms of brass tubing and hickeys"? Who, I repeat, ever talked to a fixture manufacturer in those terms? Not anybody in the lighting business.

Of course this writer realizes that he is simply scolding—further, that scolding makes ten people sore where it makes one person think. Yet he is convinced that if one out of ten readers of this page should start to think about lighting in terms of wanted merchandise instead of, as at present, in terms of unwanted brass, glass and wattages, this industry would get somewhere in a very great hurry.

Talking of all this the other day to a man of great prominence in the electrical industry, one with unusual opportunities for over-the-horizon observation, he said:

A revolution under way?

"What has been done in the better light—better sight activity does not amount to so much as what it signifies. To be sure, it has added enormously to the industry's lighting load, has sold very many thousands of dollars' worth of equipment, but what is more important is that it seems to have opened the way to get an intelligent interest in lighting by putting style into it and making it decorative and desirable. That is the big opportunity we face. For until we have a new vogue in lighting that is dramatically different, one that makes the old fixtures appear to be only so much ceiling junk, there will be no real advance, but only more sales of a commodity with which the public is today quite definitely dissatisfied."

Which brings us rather abruptly to a point of grave import to the utility industry at this time.

We are hearing more than is pleasant of rate agitation. One wonders—observing the public's willingness-to-spend reaction to this "new approach" method of lighting sales—one wonders whether the basis of this agitation is really rates or is it impatience with the quality of what is delivered for the rates charged? For myself, I have gladly paid more than three dollars for a dozen good eggs, but I wouldn't pay a dime a thousand dozen for bad eggs.

It occurs to me that in lighting we've been delivering some pretty bad eggs.

System Stability Calculations Reduced to a Practical Base

By R. H. DUVAL and L. J. EASTMAN

Engineering Department, Southern Sierras Power Company.

Stability problems are ever confronting the power system engineer. The necessity for making definite calculations dictates the application of theory to practice in a ready manner if stability is to be secured in actual operations.

On the basis of a four-machine set-up the authors have in this discussion outlined the approach; in a later article they will carry through with a specific example.

Principles used and the method of attack should be useful to all engineers dealing with this problem.

WITHOUT pretending to offer anything particularly new in stability theory, this article presents a multi-machine problem worked out in detail in the hope that it may be helpful to operating engineers whose power systems, because of long lines and isolated plants, cannot be handled readily on a two-machine basis. The method used in this problem has been employed on the system of the Southern Sierras Power Company and the Nevada-California Power Company and has been found to approximate the results very closely obtained in actual system operation.

In general,* system stability under fault conditions or any conditions altering the system network depends upon (1) the ability of the circuits between the various stations and machines to transmit synchronizing power, and (2) upon the inertia of the various machines. A relatively light machine, of course, suddenly having its electrical output changed without a corresponding change in mechanical input will be affected much more than a heavy one and will tend to lose synchronism more readily with the rest of the system. There are certain assumptions usually made in solving stability problems that are used here. These are (1) that during the period of investigation the governors of the prime movers of the generators have not sufficient time to alter the mechanical input to the generators and, hence, mechanical input is constant; (2) that the characteristics of the generator excitation are such that they will not allow an instantaneous change of internal voltage—that is, in this problem, the voltage "behind" the transient reactance of the generator—and therefore that the internal voltage is constant during the period of investigation.

Four-machine problem

This problem deals with four machines, although the method is adaptable to any number of machines. With any number of machines the simplest network that can be derived is one in which every machine is connected to every other machine and to ground through impedances. The general power equations are set up on this simplified network. From these equations the general condition of stability—that is, the flow of synchronizing power—can be determined. The method used in this problem is to solve the equations simultaneously for the power output of every machine at some particular instant at which the angles of separation of the rotors (in electrical degrees) are known. The differences between these power outputs and the mechanical inputs (assumed constant) give the amount of power available for acceleration (or deceleration) of the rotors of the various machines at that particular instant. More in detail, the angles between the rotors of the various machines on a power system are constant when a system is operating normally in a steady state and can be determined. (It should be remembered that the angle a rotor of a machine makes with the rest of a power system is proportional to its electrical output.) At the instant a fault appears on the system the system network changes, with machines still at their original angles. Solving the general power equations or, as they are generally known, power-angle equations, with the constants of the new network, but with the rotor angles of separation as before, the power available for acceleration may be found for the instant that the fault is applied. It then can be assumed that this available power is constant for a short interval of time (in this problem 0.1 second). The accelerations of the machines during the interval and the angular positions of the rotors at the end of the interval can be calculated, knowing the inertias of the rotors, the accelerating power and the rate of change of the angular position or velocity at the beginning of the interval. The angular positions at the end of the interval can be inserted in the power-angle equations and the accelerating power determined for the next succeeding interval, etc. From the results angle-time curves can be plotted showing the angular position of every machine with respect to every other at any instant, and in turn whether the machines tend to stay together or to leave each other, indicating system stability or instability.

Accuracy depends upon intervals chosen

Obviously, the power causing change in speed of the rotors is not constant over an interval of time, but is constantly changing with the angle of separation of the

Equations used in this article are found in "Electric Journal," June, 1930, in the article by Otto Muehleisen.

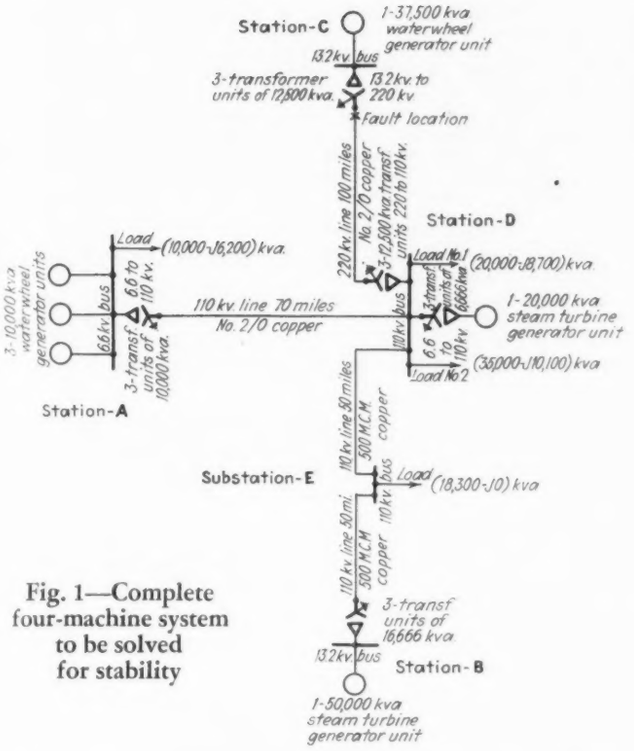

Station-C
1-37,500 kva waterwheel generator unit
13.2kv bus
3-transformer units of 12,500 kva.
13.2kv to 220 kv
Fault location
220 kv. line 100 miles No. 2/0 copper
3-12,500 kva transf. units 220/to 110 kv.
Station-D
Load (10,000-J6,200) kva.
3-10,000 kva waterwheel generator units
6.6 to 110 kv.
6.6kv bus
3-transf. units of 10,000 kva.
110 kv. line 70 miles No. 2/0 copper
110kv bus
Load No.1 (20,000-J8,700) kva.
3-transf. units of 6666 kva.
6.6 to 110 kv
1-20,000 kva steam turbine generator unit
Load No.2 (35,000-J10,100) kva
Station-A
110 kv. line 50 miles 500 M.C.M. copper
Substation-E
110kv bus
Load (18,300-J0) kva
110 kv. line 50 mi. 500 M.C.M. copper
3-transf units of 16,666 kva.
13.2kv bus
Station-B
1-50,000 kva steam turbine generator unit

Fig. 1—Complete four-machine system to be solved for stability

various machine rotors, hence the shorter the intervals the more accurate will be the results. However, if no particular machine tends to hunt badly a 0.1 second interval does not introduce an error that will vitiate the results as far as an indication of stability or instability is concerned. If some machines on the system, such as small generators or condensers (which are treated as generators), are tossed around freely by the others, a method of correcting the power increment (power available for acceleration or deceleration), given in the succeeding installment, may be used that takes into account the change in accelerating power during the interval.

A system for investigation has been set up as shown in the accompanying diagram. This system represents no particular or actual power system, but has been arranged in such a manner as to lend itself to ready exposition and to involve such networks as are commonly contained in power systems. Obviously, as indicated by the 220-kv. No. 2/0 copper circuit between station "C" and station "D," this system has not been set up according to general engineering practice.

System data

Station "A"—Three 10,000-kva. waterwheel generators, terminal voltage 6,600, transient reactance (x_1) = 40 per cent, negative sequence reactance (x_2) = 50 per cent, no damper windings. Three 10,000-kva. transformer units, 6.6 kv. to 110 kv., grounded star-delta connection, positive and negative sequence impedance = (.7 + j8.0) per cent.

Station "B"—One 50,000-kva. steam turbine-generator, terminal voltage 13,200, transient reactance (x_1) = 15 per cent, negative sequence reactance (x_2) = 10 per cent, no damper windings. Three 16,666-kva. transformer units, 13.2 kv. to 110 kv., grounded star-delta connection, positive and negative sequence impedance = (.6 + j9.0) per cent.

Station "C"—One 37,500-kva. waterwheel generator, terminal voltage 13,200, transient reactance (x_1) = 30 per cent, negative sequence reactance (x_2) = 50 per cent, no damper windings. Three 12,500-kva. transformer units, 13.2 kv. to 220 kv., grounded star-delta connection, positive and negative sequence reactance = (.7 + j8.0) per cent.

Station "D"—One 20,000-kva. steam turbine-generator, terminal voltage 6,600, transient reactance (x_1) = 18 per cent, negative sequence reactance (x_2) = 14 per cent, no damper windings. Three 6,666-kva. transformer units (machine to 110-kv. bus), 6.6 kv. to 110 kv., grounded star-delta connection, positive and negative sequence reactance = (.8 + j7.0) per cent. Three 12,500-kva. transformer units (line C-D to 110-kv. bus), 220 kv. to 110 kv., grounded star-delta connection, positive and negative sequence reactance = (.6 + j6.0) per cent.

Station "E"—Merely a "substation in line" with no transformers, and with a load taking directly off of the 110-kv. bus.

Line A-D—110 kv., 70 miles long, No. 2/0 copper, single circuit, 15 ft. equivalent spacing.

Auxiliary constants: A = .98900 + j .00535; B = 30.6 + j60.1; C = —.000001 + j .000347; D = .98900 + j .00535

Line B-E and Line E-D—110 kv., 50 miles long, 500 mcm. copper, single circuit, 15 ft. equivalent spacing.

Auxiliary constants, A = .99500 + j .00083; B = 5.96 + j38.50; C = .000000 + j .000276; D = .99500 + j .00083

Line C-D—220 kv., 100 miles long, No. 2/0 copper, single circuit, 21 ft. equivalent spacing.

Auxiliary constants, A = .97900 + j .01040; B = 43.4 + j89.6; C = .000002 + j .000471; D = .97900 + j .01040

System loads

Load on the 6.6-kv. bus at station "A"	10,000 — j 6,200 kva.
Load No. 1 on the 110-kv. bus at station "D"	20,000 — j 8,700 kva.
Load No. 2 on the 110-kv. bus at station "D"	35,000 — j10,100 kva.
Load on the 110-kv. bus at station "E"	18,300 — j 0 kva.
Input of station "A" at station "D" 110-kv. bus	10,000 — j 0 kva.
Input of station "B" at station "D" 110-kv. bus	10,000 — j 2,800 kva.
Input of station "C" at station "D" 110-kv. bus	20,000 — j 9,500 kva.
Input of station "D" generator at station "D" 110-kv. bus	15,000 — j 6,500 kva.

System simplifications

With most power systems there is one main station, usually, at which an accurate check is kept on bus voltage, loads, condensive capacity required by systems, etc., and if calculations are made with this station as a base, the calculations will be somewhat simplified. For that reason the system loads as given above are, as nearly as possible, given in reference to station "D." Also in the above data (—j) indicates lagging load.

In simplifying this system all impedances will be converted to admittances and these admittances multiplied by 1,000 for convenience in handling. The first simplification will be (1) to convert all machine and transformer impedances which are given in per cent on kva. rating to admittances on a 110-kv. base voltage; (2) combine line auxiliary constants with line transformer constants and then convert the resulting auxiliary constants into an equivalent pi circuit in admittances on 110-kv. base, and (3) convert loads into equivalent admittances on a 110-kv. base. This simplification is shown in some detail:

$$\text{mhos } (\times 10^3) \text{ on 110-kv. base} = \frac{1{,}000}{\text{impedance}} = \frac{\text{kva} \times 100}{\text{kv.}^2 \times \text{per cent}} \qquad (1)$$

Where kva. is the kva. rating of the machine
kv. is the base voltage (110 kv.)
per cent is the per cent reactance of the machine on its own kva. base.

Station "A" generator transient admittance on 110-kv. base by formula (1) equals:

$$\frac{10{,}000 \times 100}{110^2 \times (j40)} = -j2.07 \text{ mhos } (\times 10^3)$$

Similarly,

Station "B" generator admittance on a 110-kv. base equals:		—j27.55
Station "C" generator admittance on a 110-kv. base equals:		—j10.33
Station "D" generator admittance on a 110-kv. base equals:		—j 9.18
Station "A" transformer admittance on a 110-kv. base equals:	2.69	—j30.75
Station "B" transformer admittance on a 110-kv. base equals:	3.04	—j45.71
Station "C" transformer admittance on a 110-kv. base equals:	3.37	—j38.45
Station "D" transformer (generator to bus) admittance on a 110-kv. base equals:	2.66	—j23.31
Station "D" transformer (line C-D to 110-kv. bus) admittance on a 110-kv. base equals:	5.12	—j51.14

Next, the auxiliary constants of lines B-E and E-D and the load admittance at station "E" will be combined to give the constants of an equivalent line from station "D" 110-kv. bus to the line side of the transformer at station "B." The following formulas are used:

$$\begin{aligned} A &= A_1A_2 + C_1B_2 + A_1B_2Y \\ B &= B_1A_2 + D_1B_2 + B_1B_2Y \\ C &= A_1C_2 + C_1D_2 + A_1D_2Y \\ D &= B_1C_2 + D_1D_2 + B_1D_2Y \end{aligned} \qquad (2)$$

Where A, B, etc., are the equivalent auxiliary constants
A_1B_1, etc., are the auxiliary constants of line E-D
A_2B_2, etc., are the auxiliary constants of line B-E
Y is the admittance of the load at station "E" and is equal to power in kva. over the voltage^2 in kv. all times 10^{-3}

Inserting the numerical values in formulas (2) the auxiliary constants of the equivalent line are:

$$\begin{aligned} A &= .98831 + j\ .06121 \\ B &= 9.61 + j77.31 \\ C &= .001496 + j\ .000552 \\ D &= .98832 + j\ .06119 \end{aligned}$$

To include the transformer impedance at station "B" in the above equivalent auxiliary constants, the following formulas are used:

$$\begin{aligned} A &= A_1 + C_1Z_{tt} \\ B &= B_1 + D_1Z_{tt} \\ C &= C_1 \\ D &= D_1 \end{aligned} \qquad (3)$$

Where A, B, etc., are the new auxiliary constants including the transformer
A_1, B_1, etc., are the auxiliary constants of the equivalent line without the transformers.
Z_{tt} is the impedance of the transformer at station "B" (or sending end).

Inserting numerical values in formulas (3) the auxiliary constants for an equivalent line from station "B" bus to station "D" 110-kv. bus are:

$$\begin{aligned} A &= .97846 + j\ .09459 \\ B &= 9.71 + j99.02 \\ C &= .001496 + j\ .000552 \\ D &= .98832 + j\ .06119 \end{aligned}$$

The auxiliary constants of line C-D will now be combined with the impedances of the transformers at each end of the line to give the auxiliary constants of an equivalent line from station "C" bus to station "D" 110-kv. bus on a 110-kv. base:

$$\begin{aligned} A &= \frac{T_r}{T_s}(A_1 + C_1Z_{tt}) \\ B &= \frac{1}{T_rT_s}(B_1 + A_1Z_{tr} + D_1Z_{tt} + C_1Z_{tr}Z_{tt}) \\ C &= C_1T_rT_s \\ D &= \frac{T_s}{T_r}(D_1 + C_1Z_{tr}) \end{aligned} \qquad (4)$$

Where A, B, etc., are the auxiliary constants of the new equivalent line

T_r is $\dfrac{\text{Voltage on network side of transformer at receiving end}}{\text{Voltage on opposite side of transformer at receiving end}}$

T_s is $\dfrac{\text{Voltage on network side of transformer at sending end}}{\text{Voltage on opposite side of transformer at sending end}}$

Z_{tt} is the impedance of the transformer at the sending end on a 220-kv. base and equals the ratio of 220 to 110 squared times one over the admittance on 110-kv. base or

$$\frac{4 \times 1{,}000}{3.37 - j38.45} = 9.04 + j103.24 \text{ ohms}$$

Z_{tr} is the impedance of the transformer at the receiving end on a 220-kv. base.
A_1, B_1, etc., are the constants of line C-D on a 220-kv. base.

Assuming station "C" the sending end and station "D" the receiving end and inserting the numerical values in formulas (4):

$$\begin{aligned} A &= .93036 + j\ .01445 \\ B &= 14.32 + j65.73 \\ C &= -.000008 + j\ .001884 \\ D &= .94251 + j\ .01390 \end{aligned}$$

By the same methods from which the auxiliary constants were derived for the equivalent lines between stations "B" and "D" and stations "C" and "D" the constants are derived for an equivalent line between station "A" bus and the 110-kv. bus at station "D" and are as follows:

$$\begin{aligned} A &= .97780 + j\ .00630 \\ B &= 33.22 + j92.03 \\ C &= -.000001 + j\ .000347 \\ D &= .98900 + j\ .00535 \end{aligned}$$

We now have auxiliary constants on a 110-kv. voltage base for equivalent lines from each station bus to the 110-kv. bus at station "D." These can be simplified further by transforming each set of constants into an equivalent pi circuit as follows:

$$\begin{aligned} y_r &= \frac{(A-1) \times 10^3}{B} \\ y_s &= \frac{(D-1) \times 10^3}{B} \\ y_L &= \frac{(1) \times 10^3}{B} \end{aligned} \qquad (5)$$

Where y_r is a load admittance (multiplied by 1,000) on receiving end bus
y_s is a load admittance (multiplied by 1,000) on receiving end bus
y_L is an admittance connecting the sending end bus and the receiving end bus (multiplied by 1,000)

Inserting the auxiliary constants of the equivalent line from station "A" bus to the 110-kv. bus at station "D" in the formulas (5):

$$y_r = \frac{(-.02220 + j.00630) \times 10^3}{33.22 + j92.03} = -.02 + j.24$$

$$y_s = \frac{(-.01100 + j.00535) \times 10^3}{33.22 + j92.03} = .01 + j.12$$

$$y_L = \frac{10^3}{33.22 + j92.03} = 3.47 - j9.61$$

In a like manner, station "B"—station "D" circuit:

$$\begin{aligned} y_r &= .92 + j.31 \\ y_s &= .60 + j.18 \\ y_L &= .98 - j10.00 \end{aligned}$$

Station "C"—station "D" circuit:

$$\begin{aligned} y_r &= -.01 + j1.06 \\ y_s &= .02 + j.88 \\ y_L &= 3.16 - j14.52 \end{aligned}$$

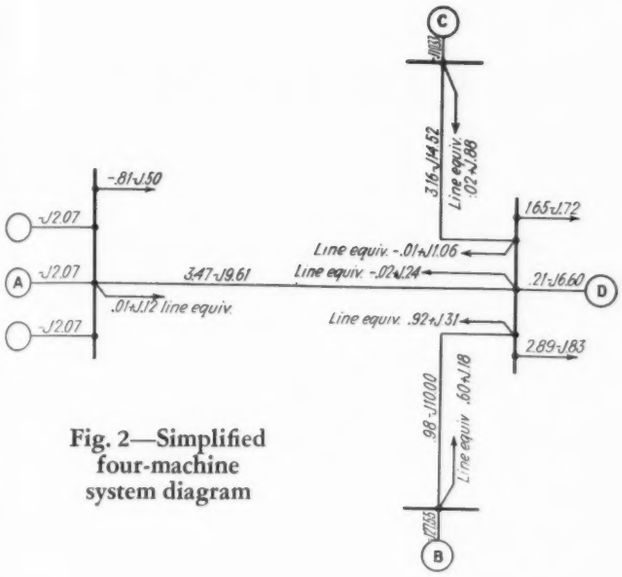


Fig. 2—Simplified four-machine system diagram

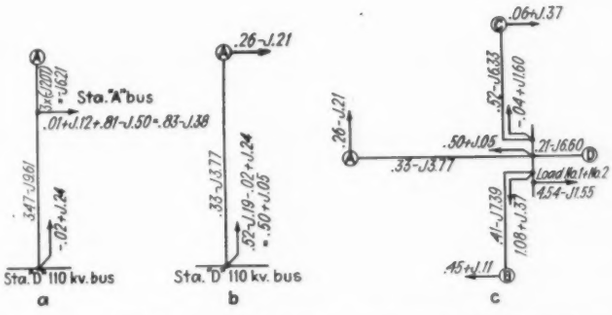


Fig. 3—Typical examples of system part simplification

The admittance of the generator and the transformer at station "D" are combined into a single admittance:

$$\frac{(-\text{j}9.18) \times (2.66 - \text{j}23.31)}{-\text{j}9.18 + 2.66 - \text{j}23.31} = .21 - \text{j}6.60$$

To convert the load in kva. on the 6,600-volt bus at station "A" to an admittance it is necessary to find this bus voltage on a 110-kv. base, or, to be more exact, on the base voltage of 110 kv. assumed at station "D" bus. The auxiliary constants of the equivalent line from this bus to the bus at station "D" have already been calculated, so all that is necessary is to employ the equation

$$E_s = E_r A + \sqrt{3} I_r B \qquad (6)$$

Where E_s is the bus voltage at station "A" on a 110-kv. base, line to line

E_r is the bus voltage at station "D" on a 110-kv. base, line to line

I_r is the line current at station "D"

Substituting in formula (6)

$$E_r = 110{,}000 + \text{j}0$$

$$\text{and } \sqrt{3} I_r = (10{,}000 - \text{j}0) \div 110 = 90.91 + \text{j}0 \text{ amp.}$$

$$E_s = 110{,}000\,(.97780 + \text{j}.00630) + 90.91\,(33.22 + \text{j}92.03)$$

$$= 110{,}578 + \text{j}9{,}059 \text{ volts}$$

Then as power at any point is the conjugate of the voltage, E_c, by the current,

$$\text{Power} = E_c 3I = E_s \times Ey$$

$$\text{or } y = \frac{\text{Power}}{E_s \times E} \qquad (7)$$

Substituting in (7)

$$y\,(\text{x}10^3) = \frac{(10{,}000 - \text{j}6{,}200) \times 10^3}{(110.578^2 + 9.059^2) \times 10^3}$$

$$= .81 - \text{j}.50, \text{ the admittance of the load on the 6.6-kv. bus at station "A" on 110-kv. base.}$$

Then the admittance of load No. 1 on the 110-kv. bus at station "D" by substituting in formula (7)

$$y\,(\text{x}10^3) = \frac{(20{,}000 - \text{j}8{,}700) \times 10^3}{110^2 \times 10^3} = 1.65 - \text{j}.72$$

Similarly the admittance of load No. 2 is

$$(\text{x}10^3)\ y = \frac{(35{,}000 - \text{j}10{,}100) \times 10^3}{110^2 \times 10^3} = 2.89 - \text{j}.83$$

The results of all the station, line, load simplifications are indicated in Fig. 2.

The system as shown in Fig. 2 can be simplified still further by paralleling load admittances on the same bus and by converting the various three-point stars formed by each station generator, station bus with load and equivalent load admittances, and the admittance from the station bus to the station "D" 110-kv. bus. It should be remembered that admittances are paralleled by simply adding. The method used in converting a three-point star network to an equivalent delta mesh is shown in the appendix. For example, the reduction of the network from station "A" generator internal voltage to the station "D" 110-kv. bus will be made. It should be noted that all machine admittances are to the internal voltage, which is assumed constant.

In Fig. 3a the network is shown with the admittances of the various parts of the network:

$$y_1 = -\text{j}6.21 \qquad \frac{1}{y} = \Delta = \frac{4.29 + \text{j}16.20}{280.84}$$

$$y_2 = .82 - \text{j}.38 \qquad = .0153 + \text{j}.0577$$

$$y_3 = 3.47 - \text{j}9.61 \qquad \Delta y_1 = .3582 - \text{j}.0949$$

$$y = 4.29 - \text{j}16.20 \qquad \Delta y_2 = .0344 + \text{j}.0415$$

$$y_{12} = \Delta y_1 y_2 = .2577 - \text{j}.2139$$

$$y_{13} = \Delta y_1 y_3 = .3310 - \text{j}3.7715$$

$$y_{23} = \Delta y_2 y_3 = .5183 - \text{j}.1871$$

The results of this simplification are indicated in Fig. 3b. In the same manner the whole system as shown in Fig. 2 is simplified and the final network is shown in Fig. 3c.

A succeeding issue of ELECTRICAL WORLD will contain the second part of this article and show how to make detail calculations of performance.

Inspected Meters Increase Revenue

One Northwest utility made 24,363 inspections of service and found 211 cases of meter tampering, of which 145 revealed jumpers. In addition there were 466 unmetered circuits, 136 flat-rate water heaters wrongly billed and 277 not billed at all. Five districts were involved, and for one of these the cost of its 4,406 inspections, including mileage and hotel expense, was $1,389.69. The revenue recovery of $1,471.90 exceeded this cost and there was further benefit in discovering needed repairs to meters, service wires and overhead distribution. These data appeared in a paper read to the Northwest Electric Light & Power Association by R. F. Davies of Grays Harbor Railway & Light Company.

Range-Wiring Costs Cut to $17

Two-thirds the customer cost of range wiring has been lopped off by mounting the range switch within the outdoor meter box.

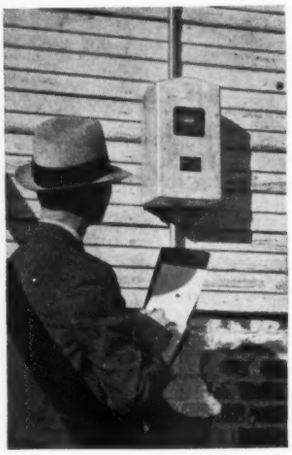
Utility may well capitalize the outside installation as a service element.

IN COMMON with many utilities all over the country the Birmingham Electric Company is now engaged in a program of moving lighting meters from the inside to the outside of customers' homes where they are being inclosed in specially designed protective cases.

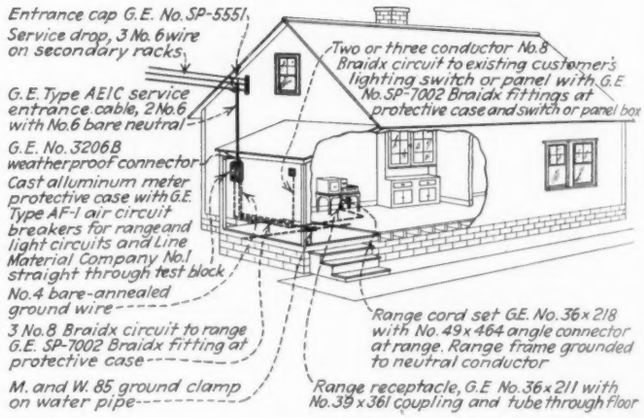
As part of this program the engineering department has designed a wiring hook-up that reduces the cost of an electric range installation by approximately two-thirds. Where there is an electric range in the home the meter case installed is of sufficient size to house the meter, test block and circuit breakers controlling both the range and lighting circuits. This arrangement permits the company to own and capitalize equipment which it was necessary for the customer to pay for and own under the old style installation. Such a set-up is allowable under the new code.

Outside protective case for range customer

This case houses meter, test block and circuit breakers controlling both the range and lighting circuits. The printed notice on this case is as follows: Property of the Birmingham Electric Company. Circuit breaker handles project through bottom of box. Ranges on left, lights on right. To restore service force handle to front and push back into position. Do not break the seal. This box does not contain fuses.



Smaller protective case used where customer has no electric range


Entrance cap G.E. No. SP-5551
Service drop, 3 No. 6 wire on secondary racks
G.E. Type AEIC service entrance cable, 2 No. 6 with No. 6 bare neutral
G.E. No. 3206B weatherproof connector
Cast alluminum meter protective case with G.E. Type AF-1 air circuit breakers for range and light circuits and Line Material Company No. 1 straight through test block
No. 4 bare-annealed ground wire
3 No. 8 Braidx circuit to range G.E. SP-7002 Braidx fitting at protective case
M. and W. 85 ground clamp on water pipe
Two or three conductor No. 8 Braidx circuit to existing customer's lighting switch or panel with G.E. No. SP-7002 Braidx fittings at protective case and switch or panel box
Range cord set G.E. No. 36 x 218 with No. 49 x 464 angle connector at range. Range frame grounded to neutral conductor
Range receptacle, G.E. No. 36 x 211 with No. 39 x 361 coupling and tube through floor

Range wiring by this method cuts cost to customer

In the past considerable handicap was found in the sale of electric ranges due to the fact that the installation cost ran not less than $45 to $50, sometimes even more. The estimated cost of the interior wiring under the improved plan is only $17 per range, which includes range plug, cord and receptacle. Under the present arrangement in Birmingham dealers are absorbing this amount in the list price of the range, so that the customer is not required to pay anything for an installation. The interior wiring has become simply a matter of installing a few feet of three-conductor cable to the range location and an additional few feet of two- or three-conductor cable to the existing lighting switch. Needless to say that the elimination of the installation cost to the customer is proving a tremendous advantage in the sale of electric ranges.

The new type of range installation is quite flexible. Should a customer move it would be a simple matter also to move the protective case to the new address. A standard meter case could then be installed at the old address to take care of the incoming tenant's lighting, provided, of course, he did not have an electric range also. Instead of this procedure the installation could be left intact and be devoted exclusively to lighting service, or the range circuit breaker could be removed and the meter replaced with a smaller meter to provide lighting connections for the new tenant.

Range readily disconnected

Under the new arrangement a surface type range receptacle is provided in the kitchen so that the range may be plugged in just like a floor lamp. This enables the customer, without the aid of an electrician, to unplug the range and move it about for such operations as cleaning, laying linoleum, or even in moving to a new home. The plug also serves under the code as a disconnecting switch.

The cost of the exterior wiring, which the company can capitalize, in the range installation is estimated with quantity purchases of material at $21.83. This includes the protective case, circuit breakers and service entrance,

but is exclusive of overhead service and meter. The cost of the interior wiring is estimated on the same basis at $17. Some material prices have advanced since these estimates were made.

The estimated cost of the service, meter box, including test block and circuit breakers and the larger meter, is about $20 more than the company's standard two-wire lighting service with outdoor meter installation. The saving to the customer comes, as already pointed out, in the ability of the company to capitalize this property and at will move the box, service entrance cable and service.

The new type range installations fit well into the company's general program of relocating all domestic lighting meters. The work was begun with the primary object of preventing the unlawful diversion of energy, but for other reasons the new arrangement has proved satisfactory to both the company and its customers. Meter readers do not find it necessary because of locked homes to "call back" or else render estimated bills. The customer, on the other hand, is not bothered by the meter reader's monthly call. Meter readers also find that they can read the meters more satisfactorily on the outside.

The company this year began advertising its program of meter changing. Customers desiring their meters moved at once without waiting for meter crews to reach their homes in normal course were invited to call the company. Dozens of such calls from customers have been received voluntarily asking that their meters be relocated.

The utility has about 50,000 domestic meters and up until mid-February 7,248 had been given outside locations. This included 300 conversions in 1930, none in 1931, 2,861 in 1932, 3,600 in 1933 and 478 during the early part of 1934. The change-over will possibly be made at a more rapid rate in the future. Protective cases used so far are of aluminum.

Make Utility Accounts Aid Management Control

Revamped accounting has been demanded of New York State's utilities. Demurring at the prospective costs and at some of the depreciation principles, they asked for a rehearing, but lost. The board's expert here expounds the concept that ledger items, free of overheads, should be framed to reveal the true departmental efficiency in accomplishing the functional jobs that intervene between the coal pile and the customer. The order is now in effect.

By ROBERT T. OLDFIELD
Senior Electrical Engineer, New York State Public Service Commission

The object of business enterprise is the creation of profit
—Thorstein Veblen.

PROFESSOR VEBLEN in his book "The Theory of Business Enterprise" begins with this trite but true statement. He further goes on to state that the method of accomplishing this "is essentially purchases and sales." This is also quite obvious, but between these two limits, i.e., the purchase of some raw material and the sale of the finished product, there is an essential step. Economists formally called this step "The addition of an increment of value." There are several ways in which this can be accomplished, but we are here concerned only with two, the increase in value due to change of form and place. Thus coal is converted into heat, which in turn is converted into electrical energy, thus adding an increment of value due to a change in form of the original material. Secondly, this energy is moved from the power plant to the consumers' premises, thus adding another increment of value due to a change of place.

The success of the enterprise, and by success is meant the creation of a profit, depends as much on the efficient performance of these two transformations of value as does the efficient buying and selling that Veblen mentions. However, the only way that it can be determined whether or not these functions are being efficiently performed is from a record of their performance; in other words, the books of account. In order to be effective these accounts must reflect exactly the actual physical performance of these functions. If the accounts do not do this—that is, if they contain besides the actual money spent allocations of overhead—the significance of the figures are vitiated and effective control of the functions is impossible. Consequently the most efficient performance is not possible because the actual performance is not known. There is no sound basis for judgment, since judgment is limited by the amount of reliable information available.

Omit the overheads from functional accounts

However, what is more important, especially in the electric power industry, is that every function performed, or every department, must be identical with the ledger accounts in name and meaning. For example, if there is a function called "transmission," we must have a ledger account called "transmission expense," and in this account there must be no other expense reported aside from that expended on the transmission function. Neither should there be any prorations of overhead, as

previously mentioned, if this function is to be effectively controlled. It perhaps should be mentioned that a very special view of the use of accounts is taken here; that is, their use in managerial control. This necessarily conflicts somewhat with the classical and fundamental objective of accounts; that is, to differentiate between capital and surplus. In practically all business enterprises (except public utilities) the functions to be performed are first determined and then corresponding ledger accounts are set up with the same name as the functions or departments.

In the electric power industry, however, a unique situation exists which makes such a straightforward and logical procedure difficult if not impossible. Here it seems the cart is put before the horse. A uniform system of accounts has been established and all electric power companies are required to use it. This system of accounts, while unquestionably useful for some purposes, is pathetically ineffective in management control. This is because the names of the ledger accounts may not be synonomous in name and meaning with the various departments.

Organizations differ, but functions are identical

IT CANNOT be said, as many hasty critics have, that this is the fault of a system of accounts. It is well known to every one familiar with the electric power industry that there are often unique situations which make the organization and administration of one company different from another. Obviously, therefore, the various companies may have to be somewhat different in their organization set-ups. However, they all perform fundamentally the same physical functions, and these are the titles of the principal ledger accounts as given in the uniform system of accounts. There can be no criticism of the uniform system of accounts on the grounds that it is not effective in management control, since it is merely a matter of grouping the expenses of operation in such a manner that they coincide with the ledger accounts as defined by the uniform system of accounts. This in no way entails a reorganization of the company; it simply means that the fundamental operating functions are being controlled instead of a miscellaneous assortment of activities which have no economic significance.

However, few if any electric power companies are so organized. The result is that ledger account A will contain part of the operating expenses of, say, departments B, C, D. Since the only method of judging the performance of the department is from the records, it is obvious that no judgment or control can be effectively exercised in this situation. Any analysis is merely an analysis of numbers without any real meaning. It should be borne in mind that most of the administration of a modern electric power system must necessarily be done at long range. That is, the executive cannot actually be on the ground and see the physical operation of the various functions. To him the accounting records are the record of the operations, and the various ledger accounts are, or should be, a true and accurate statement of the expenses of these functions. The size and complexities of the modern electric power company makes this situation imperative.

The fact remains, however, that this is not the case in most companies. In order to approach a solution to this dilemma it is necessary to inquire into the fundamental purposes of (1) the uniform system of accounts and (2) the basis of the functionalization or departmentalization.

First let us consider the intent of the uniform system of accounts. The unique characteristic of the public utility industry and the conditions under which this industry operates makes the use of a uniform system of accounts imperative. Operating under regulation, the essence of which is the control of profit based upon the property used and usable, the situation is so complex and the number of companies so great that without a uniform system of accounts regulation would be practically impossible. Any one who has had experience in trying to analyze public utility reports before the introduction of the uniform system of accounts will readily appreciate this situation. Not only were many of the operating expenses classified in a different way but the fixed capital accounts often contained special and odd definitions known only to the company which used them. It is not meant to imply that the company deliberately tried to obscure the situation, although this criticism has been made by some persons unsympathetic with privately owned utilities.

Next with regard to the basis of departmentalization. While there are several approaches to this problem, depending on the type of business, the only one that has any significance in the electric power industry is on the basis of the physical functions performed. This is precisely what the uniform system of accounts exemplifies. The name of the principal ledger accounts are the principal and significant physical functions performed by any electric power company regardless of any unique conditions in the territory being served. It may be found expedient to have special departmental names but the functions remain the same.

It is possible, and as a matter of fact true, that a great many utility organizations, like Topsy, just grew up. That is, as the company developed and the operation became more complex the personnel was increased with more special functions in a more or less random fashion.

Only a matter of regrouping subsidiary functions

SO IT would seem that we have a problem similar to the irresistible force and the immovable mass. On the one hand we have a system of accounts prescribed. On the other hand we have a company divided up into departments, the names of which and the functions of which are not identical with the ledger accounts. The problem is to operate these departments as efficiently as possible, having no other information than that given in the accounts. Obviously a compromise of some kind must be effected. A little reflection would show that this can be very readily done, not by completely reorganizing the company, but by regrouping the subsidiary functions in such a manner that the total expense of any group goes exclusively to one ledger account, and this ledger account contains no expenses from any other group or department. This adjustment of course is largely on paper. That is, the principal changes would be on the organization charts in which some lines of authority would be changed. Thus Mr. A in charge of subsidiary functions would continue his work and organization as usual, but the expenses of his group and his responsibility would be changed from department Y to department Z. When this situation is effective a direct and positive control of operating expenses will be possible. Then, and only then, will it be possible to operate the company at its maximum efficiency.

LETTERS TO THE EDITOR

Quiet Capacitor Motor Has Low Starting Currents

To the Editor of the ELECTRICAL WORLD:

In his article in the March 3, 1934, issue of ELECTRICAL WORLD G. H. Hall brought out a point that is often overlooked or misunderstood. It is that a large part of the vibration and noise in single-phase motors is due to the pulsating torque. Here the capacitor motor, with its approximation to the polyphase operation and consequent reduced pulsation in torque, has reduced both vibration and noise. It is not at all well appreciated, however, that the capacitor motor need not be a squirrel-cage motor. The series or repulsion-start characteristic is available in capacitor motors along with the high locked-rotor torque and low locked-rotor current that distinguish the repulsion-start from the squirrel-cage. This all makes the more quiet capacitor motor available in the integral horsepower sizes where it is now the general practice to use the relatively noisy repulsion-induction motor.

Comparative tests of these two types show that the starting and running characteristics of the repulsion-start motor are appreciably improved by the use of a condenser.

In the same issue was a letter by William Shuler advocating reduction in distribution transformer impedances as a step toward easier and better voltage regulation. The data in the above tables show that this acute distribution problem can in part be met by more extensive resort to capacitor motors with their more favorable starting torque and their familiar lowered starting current characteristics.

Table I—Characteristics of Repulsion-Induction Motor and Repulsion-Capacitor Motor

A 7.5 condenser connected permanently in the condenser phase. Each motor 110 volts, 60 cycle, 1,750 r.p.m.

(One-sixth horsepower repulsion-induction motor rewound to operate as one-quarter horsepower repulsion-capacitor motor.)

	⅙-Hp. Repulsion-Induction Motor	¼-Hp. Repulsion-Capacitor Motor
Line volts	118.0	118.0
No-load current (amperes)	2.96	1.84
No-load watts (watts)	80.0	70.0
Pull-out torque (foot-ounces)	24.0	30.0
Full-load torque (foot-ounces)	8.0	12.0
Locked-rotor torque (foot-ounces)	34.0	44.0
Locked-rotor current (amperes)	8.0	8.0
Full-load current (amperes)	3.2	2.64
Full-load watts (watts)	200.0	250.0
Full-load efficiency (per cent)	62.0	74.0
Full-load power factor (per cent)	53.0	80.0
Full-load apparent efficiency (per cent)	33.0	59.2
Full-load temperature rise (deg. Cent)	31.0	31.0

When the plain repulsion-induction motor was operated continuously under ⅙ hp. load the temperature rise was 41 deg. and when the repulsion-capacitor motor was operated continuously under ¼-hp. load the rise was 25 deg.

Table II—Comparison Between Split-Phase Capacitor and Repulsion-Capacitor Motor

¼ hp., 110 volts, 60 cycle, 1,750 r.p.m.

(Data in reference to split-phase capacitor motor, taken from an A.I.E.E. paper, dated January 28, 1929, by H. C. Specht of the Westinghouse Electric & Manufacturing Company.)

	Squirrel-Cage Capacitor Motor	Repulsion-Capacitor Motor
Full-load torque (foot-ounces)	12.0	12.0
Pull-out torque (foot-ounces)	41.0	30.0
Pull-out torque/full-load torque (per cent)	340.0	250.0
Locked-rotor current (amperes)	19.4	8.0
Locked-rotor torque (foot-ounces)	26.0	44.0
Locked-rotor torque per amp. (foot-ounces)	1.39	5.5
Locked-rotor torque/full-load torque (per cent)	205.0	366.0
Locked-rotor torque/pull-out torque (per cent)	63.0	147.0
Locked-rotor watts (watts)	1715.0	675.0
Full-load efficiency (per cent)	64.2	74.0
Full-load power factor (per cent)	73.0	80.0
Full-load apparent efficiency (per cent)	46.7	59.2
Capacity of running condenser (microfarads)	7.5	7.5
Capacity of starting condenser (microfarads)	45.0	7.5

EDWARD BRETCH,
President.

Advance Electric Company,
St. Louis, Mo.

High-Pressure Mercury Lamps Given Initial American Try-out

To the Editor of the ELECTRICAL WORLD:

In the March 10 issue of ELECTRICAL WORLD you published a picture of an installation of metal vapor lamps located at 231st Street and Riverdale. These lamps were called sodium lamps. Actually, this is an installation of high-pressure mercury-vapor lamps invented by Dr. Hans J. Spanner and installed by our company to serve as an illustration of the adaptability of these lamps for street lighting. It is the first installation of this type in America and the first 110-volt installation in the world.

We wish to call your attention to this error because there is such a decided difference between the sodium lamp and the high-pressure mercury-vapor lamp that we feel that your readers should be cognizant of this great dissimilarity. The primary and most apparent difference is in the color rendition and color discrimination possible under these two sources of light. The mercury lamp is not monochromatic.

The sodium lamp gives a monochromatic or pure yellow light and everything illuminated by it is completely robbed of its color and appears only as yellow or shades thereof, so that it is impossible to discern the difference between colors. Thus on a street so illuminated all license plates, for example, would appear as yellow and black, no matter what their true color as indicated under daylight might be.

On the other hand, the high-pressure mercury-vapor lamp emits a light containing strong yellow, green, blue and violet, as well as a very small amount of red, and the resulting light appears bluish-white and thus closely approaches the natural daylight. Under this light, colored objects show up quite well, greens and blues being conspicuous, although red assumes a sort of rusty brown hue.

Initially, both types of lamps have about the same efficiency, but the glass envelope is darkened much more quickly by sodium attack than by any action of the mercury vapor.

This high-pressure mercury-vapor lamp requires no heated electrodes or heater transformer and is mounted on the standard screw base.

G. O. SPANNER,
President.

Spanner Vapor Lamp Company, Inc.,
New York, N. Y.

NEWS OF THE WEEK

Nation-Wide Rate Inquiry Authorized by Congress

Providing for a census of rates charged for electric energy to residential, rural, commercial and industrial consumers throughout the United States, a joint resolution was approved by the House on April 4. In view of the fact that no amendment to the measure was made in the House and that the Senate had already approved the bill it will go to the President for signature.

The survey will be conducted by the Federal Power Commission, which will be empowered to require corporations engaged in the sale of electricity to reveal their schedules of rates charged to all classes of consumers and to submit replies to specific questions set by the commission.

Senator's Letters Bring Turmoil

What Thayer wrote in 1927 serves political expediency to bring threats of all-utility investigation and may insure passage of Lehman's long-fought-for bills in New York State.

FOUR letters written by New York State Senator Warren T. Thayer to an official of Associated Gas & Electric Company back in 1927 and 1928 and introduced before the Federal Trade Commission in Washington last week caused a state Senate investigaton of Senator Warren's relationship with the holding company to be initiated. The attendant publicity will probably result also in a Senate investigation of operations, rates and legislative activities of power companies throughout the state and may bring to prompt action and passage the Lehman utility program imposing drastic restrictions on public utility operations in New York State.

The four letters written by Senator Thayer, together with two messages labeled interoffice correspondence of the Associated Gas & Electric Company which reported the progress and the result of a village election in Chateaugay, Senator Thayer's home, were obtained from the files of the J. G. White Management Corporation. All bore dates in 1927 and 1928.

Points to legislation killed

Senator Thayer, in one letter addressed to S. J. Magee, as vice-president of Associated Gas & Electric, stated that the writer was submitting a bill for expenses in connection with a village election, and concluded: "I hope my work during the past year was satisfactory to your company, not so much for the new legislation enacted, but from the fact that many detrimental bills which were introduced we were able to kill in my committee." (Senator Thayer at that time was chairman of the Senate public service committee, and is still a member of that committee). Of the three other letters, one offered to hold up certain bills in the Senate, another said the writer had interceded successfully with a Senate sponsor of a bill permitting the municipal operation of waterworks to amend it to "make it satisfactory to your people," and the third asked about being reimbursed for $457 spent in a village election campaign.

Associated states its case

Prompt denials of any attempt to influence legislation came from Associated Gas & Electric Company and Utility Management Corporation, formerly the J. G. White Management Corporation.

Explaining that Mr. Thayer had been for many years one of the owners of the small Chasm Power Company, and that he sold control of the company to Associated interests in 1924, the statement asserted that "although he continued as an officer for some time thereafter, and in his contract agreed that the company had good franchises for the territory in which it operated, it later developed that the franchise in the village of Chateaugay had expired and Mr. Thayer undertook to secure a new franchise for the company. The expenses referred to were incurred in this connection and the election referred to was the village election at which the issue of this franchise was in question. The payments made were proper expenses to be paid by the company."

An appeal for immediate investigation of utility legislative activity and prompt passage of his bills was made by Governor Lehman, who last month went "to the people" in a radio address asking support for his program. This resulted in resolutions in both branches of the Legislature proposing such an investigation. Senator Thayer himself introduced the resolution in the Senate asking for an investigation of his actions in the Associated Gas & Electric letters and denied performing any political favors for the company, or that he had received any compensation from the company for any other than legitimate expenses incurred.

Insull in Istanbul; Awaits Extradition

Beaten in his long fight against extradition to the United States Samuel Insull this week waited in an Istanbul prison hospital ward for American authorities to return him to the United States. Turkey has formally notified the United States that it may have Insull, and the former utilities head is said to have expressed readiness to return provided he could be assured that he would not be persecuted by his enemies.

Chattanooga Is Chosen for E.H.F.A. Headquarters

Selecting Chattanooga as headquarters for the Electric Home and Farm Authority, David E. Lilienthal, its president and director of T.V.A., announced that "this location is predicated upon our ability to obtain suitable offices and display rooms at a reasonable rental. It will be necessary to have the display rooms and offices in the same building and centrally located."

The financial set-up of the E.H.F.A. has been completed. The $1,000,000 capital from NRA has been made available and, in addition, the E.H.F.A. has access to a credit of $10,000,000 from the R.F.C.

Municipal Vote Mixed

Seven Wisconsin municipalities rejected municipal ownership proposals in elections held Tuesday of this week. Six towns voted in favor of city-operated plants. Neenah, Waupaca, Cambridge, Washburn and Mount Horeb favored acquisition of local utility plants. Fond du Lac, Horicon, Two Rivers, Stevens Point, Pittsville, West Salem and Peshtigo opposed municipal ownership. Madison voted for a municipal ownership proposal, but opposed an appropriation to appraise the local private utility property, thus making it impossible for the municipal ownership advocates to proceed in acquiring it.

Free Energy Allowed to Milwaukee Consumers

Following the example set by several California utilities (ELECTRICAL WORLD, February 10, page 234), Milwaukee Electric Railway & Light Company last week announced free use for a two-month period of temporary surplus output. More than 212,000 customers of the company will benefit under the plan, which extends for the April and May meter reading periods, and permits unlimited use of current without cost, over the amount consumed during the month of March.

An excess of power available to the company is due to the inability of northern Wisconsin and upper Michigan industries to use their customary share of energy this spring, according to G. W. Van Derzee, vice-president of the utility. Commercial lighting customers, such as hotels, theaters, stores and office buildings, are included in the plan, but power customers and seasonal users are excluded. A reversal of the seasonal drop in load is anticipated by the utility, as well as increased use of current following the bargain period.

An invitation to 22 Michigan utilities to follow the lead of the Wisconsin company has been extended by Chairman John B. Balch of the Michigan Public Utilities Commission. "Melting snow and swollen streams make it possible for these companies which generate electricity through water power to increase production without substantially increasing costs," Mr. Balch said. "I think the idea of giving away this power is a good one."

San Joaquin (Calif.) Light & Power Corporation's free energy offer has resulted in tangible stimulation of appliance merchandising since it was announced last month. Retailers, distributors and manufacturers have joined with the utility in advertising and promotional schemes designed to capitalize on the offer.

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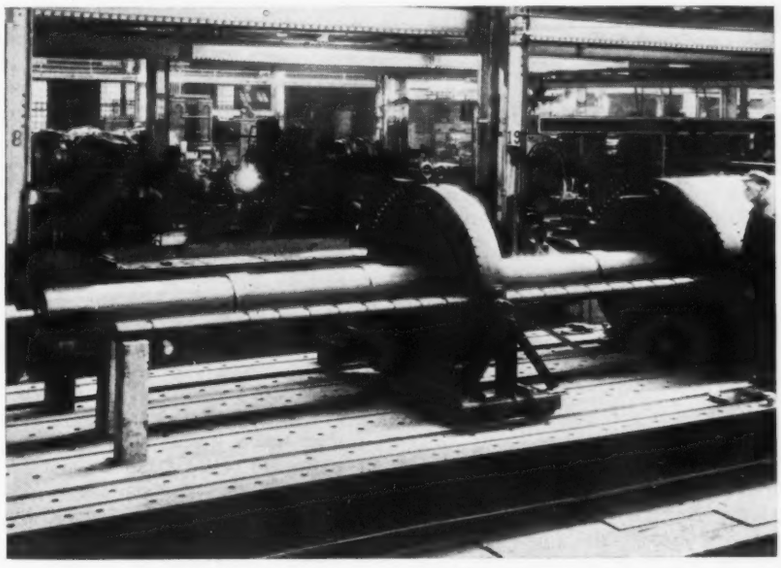
St. Paul to Tax Utility

Continuing negotiations for a franchise with the city of St. Paul, Minn., the Northern States Power Company has agreed to pay a 5 per cent gross earnings tax on electricity, gas and steam, amounting to an average of $383,000 a year. The company has accepted the terms of a one-year permit to operate while franchise negotiations are in progress. Failure to reach an agreement in the negotiations between the city and the utility in the matter of a new franchise led to agitation for a municipal plant (ELECTRICAL WORLD, December 2, page 715). Early last month, however, citizens voted down the issuance of bonds to finance the municipal project (ELECTRICAL WORLD, March 10, page 378) and negotiations for the franchise have been resumed.

183,333-KVA. UNIT FOR RICHMOND STATION



In the assembly of the rotor plates for the new 1,800-r.p.m., 165,000-kw., 13,800-volt double-winding turbo-generator unit for the Richmond station of the Philadelphia Electric Company a six-ton, 13-in. diameter, 310-in. long nickel molybdenum steel center bolt has been used. To draw up the plates for this single-cylinder unit's rotor, hydraulic bolt-pullers exerting a pull of 1,500,000 lb. are utilized. The illustration shows a plate being drawn over the center bolt on the hydraulic press in the East Pittsburgh shops of the Westinghouse Electric & Manufacturing Company.

P.W.A. to Investigate Grand Coulee Violations

Rumblings of labor trouble on the Grand Coulee Dam project in Washington are heard with the announcement that Public Works Administrator Harold L. Ickes has ordered an investigation into charges of violations of P.W.A. labor conditions in connection with the project. Charges of secret payrolls, of workers being paid by check instead of currency, that laborers had been compelled to board at the company's camp and that provisions as to hours of labor have been violated by contractors on the project prompted the investigation.

Meanwhile, P.W.A. announced from Washington that allotments to date for power generating and distributing plants total $128,860,000. Of this total $104,160,000 is being spent by the federal government and $24,700,000 has been allotted to 50 non-federal projects. Non-federal allotments to March 10 were listed in ELECTRICAL WORLD, March 17, page 418. Federal projects and allotments include the War Department's Bonneville Dam, Columbia River, Oregon, allotted $20,000,000, and Fort Peck Dam, Missouri River, Montana, allotted $25,000,000. The Bureau of Reclamation of the Department of the Interior has three projects: Grand Coulee Dam, Columbia River, Washington, allotted $15,000,000; Boulder Dam, allotted $38,000,000 to carry forward construction, $10,000,000 being for power plant machinery, and the Seminole unit of the Caspar-Alcova project, North Platte River, Wyoming, allotted $12,000,000 for the entire project.

Ickes-Bryan dispute clears

Dispute between Governor Bryan of Nebraska and Secretary Ickes over water rights agreements between the state and P.W.A.'s Platte Valley and Loup River projects seemed settled with acceptance by Secretary Ickes of revised proposals made by the Governor (ELECTRICAL WORLD, February 10, page 237). Approval was given to the provision that "to prevent unfair competition between private and municipal corporations where same are selling to the same area, the rates for such area for electric power will be the same to both at the same point of delivery and all such rates shall be satisfactory to the government." Refusing to accept Governor Bryan's provision prohibiting "lobby" fees and commissions, Secretary Ickes explained that no such costs can be charged against these projects except as approved by the Interior Department, and that payment will be made only for legitimate services rendered, and that these charges will be reasonable and will not add unduly to the costs of the projects.

Coming Meetings

Association of Iron and Steel Electrical Engineers—Youngstown, Ohio, April 12. J. L. Kelly, Empire Building, Pittsburgh.

Missouri Association of Public Utilities—Excelsior Springs, Mo., April 19-20, R. N. Beagle, 101 W. High St., Jefferson City, Mo.

Electrochemical Society — Asheville, N. C., April 26-28. Colin G. Fink, Columbia University, New York.

National Fire Protection Association—Atlantic City, N. J., May 14-18. A. R. Small, 109 Leonard St., New York.

American Institute of Electrical Engineers—Northeastern District meeting, Worcester, Mass., May 16-18. Summer Convention, Hot Springs, Va., June 25-29. H. H. Henline, 33 W. 39th St., New York.

Edison Electric Institute—Atlantic City, N. J., June 4-7. B. F. Weadock, 429 Lexington Ave., New York.

American Society of Mechanical Engineers—Semi-annual meeting, Denver, Col., June 25-28. Calvin W. Rice, 29 W. 39th St., New York.

New Southeastern Group Holds First Conference

Formed as successor to the old southeastern geographical division of the National Electric Light Association, the Southeastern Electric Exchange held its first annual conference last week at Savannah, Ga. James M. Barry, vice-president and general manager of Alabama Power Company has been elected president of the exchange, which has headquarters in Atlanta.

Among those to address the first conference of the exchange were: David M. DeBard, Stone & Webster Service Corporation; G. T. Dunklin, Westinghouse Electric & Manufacturing Company; T. L. Bissell, Alabama Power Company; C. A. Collier, Georgia Power Company; Ashton B. Collins, Edison Electric Institute; Frank A. Newton, Commonwealth & Southern Corporation, and L. A. Hawkins, General Electric Research Laboratories.

Dakota Utilities to Test 12% Gross Earnings Tax

Seeking tax relief from the 12 per cent gross earnings impost levied on them by the last legislative session, seven utilities serving North Dakota communities filed separate actions testing the constitutionality of the tax. Involved is approximately $740,000 of revenue anticipated from the levy.

Major allegations in the complaint filed by the utilities protesting the 12 per cent tax are that it is excessive and confiscatory; that the measure was passed two days after the legislative term had ended; that the state constitution does not authorize a gross earnings tax; that the constitution specifically requires property being used in general generating and distributing of electricity must itself be assessed, etc. Specifically, the plaintiffs ask a temporary restraining order against the defendants, the state tax commissioner and the state board of equalization from determining or certifying the amount of taxes for the utilities involved. An application was made by the utilities for an interlocutory injunction providing against the state taking any action until the court had decided the case on its own merits.

Companies bringing the action include North Dakota Power & Light Company, Central West Public Service Company, Northern States Power Company and three affiliates, Otter Tail Power Company and Montana-Dakota Power Company.

Miller Sees Inequities in Rate Cut Demands

Commenting on the effect of four years of economic depression upon California utilities, C. O. G. Miller, president of Pacific Lighting Corporation, calls attention in the annual report of the corporation, to the differences in utility operation and the operation of any other commercial enterprise. Discussing the question of regulation and risks, Mr. Miller states:

"There are people who think that the ability to meet financial obligations is today an indication of undue prosperity. Others assert that because the depression has brought losses and deficits to manufacturing industries and commercial enterprises the utilities should be compelled to suffer a corresponding decrease, even though, to bring about the decrease, it is necessary to lower rates which in better years produced only a fair return, but under later conditions would be wholly inadequate."

Asks protection of fair rates

This conclusion, Mr. Miller believes, is to be expected when it is considered that facts regarding utility operations are known to a comparatively small part of the population. "Unregulated businesses are permitted to accumulate generous profits in times of prosperity to tide themselves over the lean years, and it is therefore clearly inequitable, if utilities are rigidly limited in their rate of return in good times, to impoverish them by government-enforced rate reductions when times are bad.

"The utilities, which are properly debarred from exacting high rates in times of large volume consumption, should have—and by all the implications and intent of the regulatory laws do have—the protection of a continuation of fair rates when volume falls off. The loss of revenue through loss of volume is a risk inherent in the business; to increase the loss by cutting rates, merely to make the utilities suffer as heavily as other industries, unfairly places upon them a doubled risk. It is not the inequity in this situation which warrants complaint so much as the incomplete reasoning by which some people arrive at their belief that utility rates should now be reduced."

Deposit Interest Rules Clarified by Commission

Amending its requirements to bring the practice of electric and gas corporations into conformity with recent amendments to the New York State law regarding the payment of interest on customers' deposits, the Public Service Commission last week issued three rulings clarifying situations not previously covered.

Interest prior to October 1, 1933, to cover deposits which on that date had not been held for two years will hereafter be paid by utilities at the rate of 6 per cent either by cash or by crediting the amount on the next bill for service rendered the depositor after October 1, 1935, and at each two-year interval thereafter beginning October 1, 1937. Companies are required to pay interest to each depositor after he ceases to be a consumer, and each consumer on ceasing to use service has the right to withdraw his deposit and interest accrued, less payment of all bills for which deposit is security. At the same time the companies are given the right to refund any depositor the full amount of his deposit and interest when the depositor is not in arrears for bills for which the deposit is security.

MERRY-GO-ROUND

Fundamental changes were made by the judiciary committee of the House in the bill of Senator Hiram Johnson proposing to limit the jurisdiction of federal courts in utilities cases. A majority of the committee proposed less sweeping changes. Eleven of the 21 members of the committee voting agreed that it is undesirable to have suits started in state courts and, if unsuccessful, transferred to a federal court. It is known that the amended bill is not acceptable to those who want to close the federal courts to the utilities.

No progress was made during the week on a code for the electric light and power industry. It seems apparent that action on that code must await settlement of the major dispute that has arisen in the communications industry.

Another attempt by Senator Johnson to secure Reconstruction Finance Corporation financing for publicly owned electric plants is indicated by a new bill "to further the utilization of electrical energy generated in connection with federal projects," along the lines of one introduced earlier in the session, but which has not emerged from the banking and currency committee.

PAUL WOOTON,
Washington Correspondent.

Swedish Station Expanded

Expansion of generating facilities further to utilize the hydro power of the falls at Trollhattan, Sweden, is to be undertaken. Total output will be raised from 140,000 hp. to 300,000 hp. when a new plant and improvements to the old are completed. The existing machinery of the station, comprising thirteen units, will be improved and alterations made to raise the total output to 200,000 hp. The new plant will generate 100,000 hp. in two units. Cost of the work is approximately $5,000,000.

Efficient Foreign Lamps

Recent reports from abroad describe a new type of domestic electric lamp now in use on the Continent which has 20 per cent greater efficiency than the standard gas-filled tungsten filament lamps in general use at present. The outside appearance is identical with standard lamps, but the filaments are constructed to operate at higher temperatures than formerly. The filament is a doubly coiled spiral and is said to unify the efficiency of standard size bulbs to equal sizes of 100 watts and over.

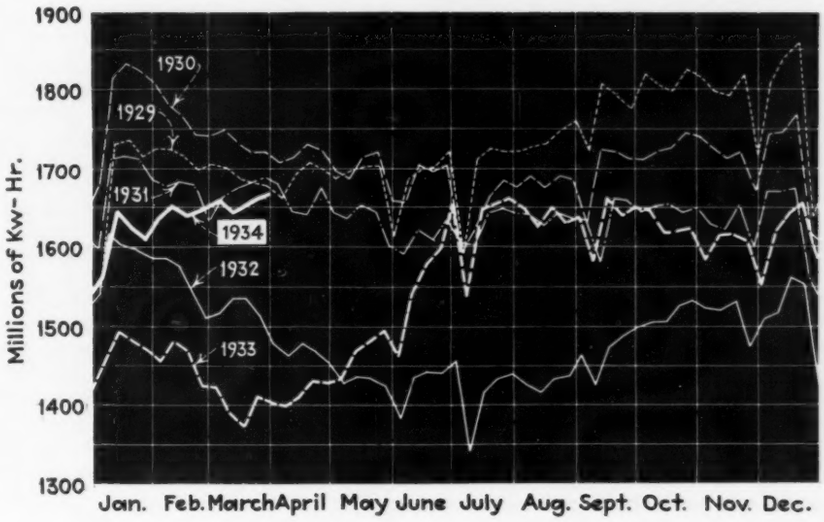
Middle Atlantic Leads in Power Station Census

About one-fourth of the electric light and power industry is concentrated in the three Middle Atlantic States, New York, Pennsylvania and New Jersey, according to a government announcement based on the Census for 1932. The statistics quoted in the accompanying table include sales for resale, and when taken in conjunction with an earlier report (ELECTRICAL WORLD, January 6, 1934, page 15) give a complete regional analysis of customers, kilowatt-hour sales and revenue. New York predominates, this state alone having 15 per cent of the customers and revenue and 12 per cent of the energy sales.

Municipal operations comprise 6.1 per cent of the total in terms of revenue, 4.9 per cent in terms of energy sales, and serve 9.3 per cent of the customers. In this group the three Pacific Coast States lead with one-fourth of the total revenue, California predominating with $22,306,819, or more than one-sixth of the national total.

Because 21,789,094,259 kw.-hr. of sales for resale by commercial companies and 580,003,032, kw.-hr. by municipal plants are included in these statistics, the totals considerably exceed the aggregate generated, 79,657,431,657 kw.-hr. (ELECTRICAL WORLD, January 6, page 14). A similar statement applies to revenue and, in less degree, to customers.

Week's Output Largest Since 1931



Electrical energy production in central light and power plants continues on a definite upward trend, according to figures announced by the Edison Electric Institute, in marked contrast with the usual decline at this season of the year. A third consecutive rise brought the output for the week ended March 31 up to 1,665,650,000 kw.-hr., the highest thus far in 1934 and surpassing that of any week in 1932 and 1933.

Comparison with corresponding weeks of other years indicates an excess of 18.8 per cent over 1933 and 12.4 per cent over 1932. The record for the week was made in 1930. This has now been approached within 3.3 per cent.

Regionally the most striking gain over 1933 is again in the central industrial area, where the percentages have for more than a month been ranging around 25 to 30. New England's gain for four weeks has been 17 per cent or better. Progress continues also in other sections, as the following table shows.

Weekly Output, Millions of Kw.-Hr.

1934		1933		1932	
Mar. 31	1,666	Apr. 1	1,402	Apr. 2	1,480
Mar. 24	1,658	Mar. 25	1,410	Mar. 26	1,515
Mar. 17	1,650	Mar. 18	1,375	Mar. 19	1,538
Mar. 10	1,647	Mar. 11	1,391	Mar. 12	1,538
Mar. 3	1,658	Mar. 4	1,423	Mar. 5	1,520

Per Cent Change from Previous Year

Region	Week ended Mar. 31	Mar. 24	Mar. 17
New England	+17.3	+19.2	+18.2
Middle Atlantic	+14.4	+12.7	+14.7
Central Industrial	+27.4	+27.0	+30.1
West Central	+10.5	+11.3	+13.8
Southern States	+17.2	+12.1	+17.5
Rocky Mountain	+22.1	+18.4	+16.8
Pacific Coast	+12.7	+12.3	+12.0
United States	+18.8	+17.6	+20.0

Refrigerator Record Set

Sales of household electric refrigerators in the United States in February broke all records for that month, according to the electric refrigeration bureau of Edison Electric Institute. Total February sales were 82,439 units, compared with 35,394 sold in February, 1933, and 53,693 in February, 1931, the previous high record for the month.

Total Sales, Including Sales to Ultimate Consumers and Sales for Resale

Census of Electrical Industries: 1932—Electric Light and Power Stations

Geographic	Number of Customers[1] Total	Commercial	Municipal	Current Sold, Kilowatt-Hours[1] Total	Commercial	Municipal	Revenue from Electric Service[1] Total	Commercial	Municipal
United States	**23,861,642**	**21,633,602**	**2,228,040**	**88,265,073,126**	**83,936,789,411**	**4,328,283,715**	**$1,975,303,955**	**$1,854,109,509**	**$121,194,446**
New England	2,225,938	2,064,858	161,080	8,120,190,941	7,905,336,782	214,854,159	182,797,544	174,926,748	7,870,796
Middle Atlantic	6,675,352	6,534,759	140,593	21,967,213,770	21,765,758,443	201,455,327	559,818,749	552,671,412	7,147,337
East North Central	5,651,145	5,144,255	506,890	21,546,548,547	20,498,878,692	1,047,669,855	461,061,595	432,424,494	28,637,101
West North Central	2,327,587	1,922,190	405,397	5,866,945,224	5,385,844,852	481,100,372	165,960,425	146,071,089	19,889,336
South Atlantic	1,778,954	1,545,003	233,951	9,388,092,655	9,064,571,543	323,521,112	180,233,065	166,469,748	13,763,317
East South Central	773,496	711,463	62,033	3,624,347,396	3,557,534,558	66,812,838	70,267,238	67,078,628	3,188,610
West South Central	1,234,780	1,105,348	129,432	4,520,804,960	4,369,735,012	151,069,948	108,975,164	102,093,709	6,881,455
Mountain	634,003	574,784	59,219	2,321,594,425	2,240,821,807	80,772,618	55,333,696	52,290,799	3,042,897
Pacific	2,560,387	2,030,942	529,445	10,909,335,208	9,148,307,722	1,761,027,486	190,856,479	160,082,882	30,773,597

[1]Includes figures relating to "Sales for resale" as follows: Number of customers, 2,940 (commercial), 291 (municipal); kilowatt-hours sold, 21,789,094,259 (commercial), 580,003,032 (municipal); revenue from electric service, $150,805,781 (commercial), $3,392,650 (municipal).

As to Rates——

• Virginia Electric & Power Company has asked the state Corporation Commission to increase its electric power rates to yield $170,000, the exact amount which the General Assembly of 1934 levied upon the company in additional state taxes. President Holtzclaw said the new petition does not seek any rates above those in effect prior to January 16, 1934. The top steps would remain at 6.5 cents. No change is made in schedule 1, the residential service rate for residences to which lighting service only is provided. The commercial service rate will be 6.5 cents for the first 150 kw.-hr. Another schedule is added applicable to small retail power service, which marks a slight increase over schedule 3, effective January 16.

• Boston Edison Company's rate case, which has been conducted before the state Public Utilities Commission for almost two years, has reached the stage of final arguments. Comparing coal costs of the company with the Boston Elevated for the years 1926-1932, inclusive, Frank H. Sullivan, who filed the original petition on behalf of a group of customers, claimed that the Edison company by not purchasing at a price equal to that paid by the Elevated had paid $2,290,105 more than it should have. He told the commission that the steam-heating division should be separated completely from the electric business, maintaining that if the commission did not have the authority to do this, it should order the company to segregate its records so that the operations of this division could be easily ascertained. Mr. Sullivan also charged that the merchandising and promotion departments of the company are operated at a substantial loss. He said the department should order the company to discontinue the sale of appliances at a loss if the deficit is made up by the ratepayers.

• New Jersey Board of Public Utilities Commissioners will ask broader powers, including authority to make effective immediate reductions in utility rates pending the completion of formal rate proceedings against the various companies providing service in New Jersey. This decision was reached by the board following conferences with Governor Moore and after legislative sentiment has to some extent been determined. In the event of the passage of the proposed legislation, which will be drawn by the board's counsel, Frank H. Sommer, the board will order a comprehensive downward revision of rates, which will remain in effect until a final determination of cases now at issue has been reached.

• Southern California Edison Company's new lighting-combination domestic service rates, designed particularly for the promotion of electric water heating, have been approved by the California Railroad Commission. The new rates apply to domestic consumers having an electric range of not less than 5-kw. capacity permanently installed or where 5 kw. of aggregate major equipment capacity in air heating and/or water heating are installed. Minimum charges are specified as $3 per month for a consumer with an electric range, $6 per month for a consumer without an electric range and 30 cents per kilowatt-hour per month for all over 10 kw. of connected load in major equipment.

• Union Electric Light & Power Company has offered the city of St. Louis a new ten-year contract for street lighting, which would save the city $25,000 a year. The over-all contract would include all street, park, bridge, traffic signal and municipal building lighting. Under the three separate contracts with the utility now in force the city pays almost $600,000 annually for lighting.

• West Virginia Public Service Commission has been ordered by the state Legislature to make valuations of all West Virginia utility companies for possible use in determining rates in the future. The commission's annual budget has been increased from $60,000 to $150,000.

Illinois hearings near close

• Public Service Company of Northern Illinois' $150,000,000 rate base for its electric properties was defended last week before the Illinois Commerce Commission by Harry J. Dunbaugh, attorney, who argued for a 7 or 7½ per cent rate of return. Mr. Dunbaugh attacked the contention of members of the commission's legal staff that the valuation of the company's electric properties for rate-making purposes should be held to a maximum of $125,000,000, with allowable return limited to 6 per cent. The company's attorney in attacking the proposal that the state commerce body enter an order for temporary reduction of electric rates insisted that any rate reduction at this time will result in a still further reduction in scant dividends now paid to security holders and threaten the credit stability of the company. At an earlier hearing attorneys for the commission had argued in behalf of a 6 per cent fair rate of return and a $125,000,000 rate base valuation of the electric properties or an allowable return of $7,500,000. On that basis, it was asserted, the company's rates could be cut as much as $2,500,000 annually. The company's figures for 1933 net earnings, given as $8,426,000, it was contended, disclosed the possibility of a reduction of approximately $1,000,000. Harry R. Booth, assistant counsel for the commission, declared that he was prepared to show that the company's net earnings last year were nearly $10,000,000.

Municipal Items

NEWPORT, ARK.—In a recent ruling by Assistant Attorney-General John Caldwell petition for submission of the question of municipal ownership of electric light and power system was ruled off the election ballot for April 3 on the ground that it had not been filed within the time prescribed by the initiative and referendum.

COLUMBIA, MO.—Test case to determine the validity of a ruling by Roy McKittrick, Attorney-General, that municipal power plants are required to pay a state sales tax is expected to follow the action of the city council, which has voted to refuse payment of the tax until the point had been ruled upon by the state Supreme Court. The Council held that the plant was non-profit making and therefore exempt from the tax. The Association for Tax Equality is using the Kansas City *Star* as an advertising medium for a vigorous campaign opposing municipal tax exemption.

RUTLAND, VT.—Citizens have approved by a vote of more than two to one an enabling act to give the city the right to operate an electric and gas plant.

MARION, IND.—Signed by far more than the necessary 5 per cent of the voters at the last election, a petition has been filed with City Council asking that body to call a special election to determine whether the city erect a municipal electric plant or condemn the property of the Indiana General Service Corporation. According to law, it is mandatory that the Council call the election.

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MARBLEHEAD, MASS.—Municipal electric plant has cut rates from 6 cents to 5¼ cents per kilowatt-hour, effective April 1, and will cut the service charge to summer residents from $6 to $3. Summer residents are credited with consuming 40 per cent of the town plant's electricity during the season.

CUSHING, OKLA.—Following a ruling by County Attorney Guy Horton that there was no authority for the election board to open ballot boxes for a recount of ballots cast in the recent municipal light plant bond election (March 17, page 419), the Interstate Power Company filed a petition in the district court in a further effort to secure such a recount. The company alleges that correct returns on the election would have shown the bond issue defeated. Almost simultaneously with the filing of this action a telegram from Washington announced confirmation of the signing of the loan and grant whereby the government agrees to finance through the P.W.A. the purchase of the bond issue involved in the court case.

FINANCIAL · · · BUSINESS

P.R.R. Orders $3,500,000 Equipment and Insulators

Orders totaling $3,500,000 for electrical equipment and insulators were placed last week by the Pennsylvania Railroad for use in its electrification of the New York-Washington line. In addition 2,500,000 lb. of bare wire and cable was ordered. The current orders bring the total placed by the railroad since February to $13,000,000 for the electrification project. Funds for these purchases were made available by P.W.A., an advance of $629,000 being made to the railroad last week.

Sharing in the orders for electrical apparatus and insulators were the following companies: Allis-Chalmers Manufacturing Company, Condit Electrical Manufacturing Company, General Electric Company, Lapp Insulator Company, Locke Insulator Company, Ohio Brass Company, Railway & Industrial Engineering Company and Westinghouse Electric & Manufacturing Company. Orders for wire and cable were placed with General Cable Corporation, Graybar Electric Company, Anaconda Wire & Cable Company, Bridgeport Brass Company, Copperweld Company, Phelps, Dodge Copper Products Corporation and J. A. Roebling's Sons Company.

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Joint Patent Invalid

No infringement of Electric Cable Joint Company's patent was committed by Brooklyn Edison Company, according to a Supreme Court ruling this week, which determined that the Torchio patent for making joints for high-tension electric cables was invalid. The original complaint against Brooklyn Edison was dismissed in New York federal court on October 5, 1932, and the lower court's ruling was sustained by the Circuit Court of Appeals on September 21, 1933. The complainant sought damages, stating that the utility had used the methods shown for making joints during the life of the patent.

Canadian Westinghouse

Net profit of Canadian Westinghouse Company, Ltd., for year ended December 31, 1933, was $469,963 after depreciation, taxes, etc., compared with $706,330 in 1932. Current assets as of December 31, 1933, amounted to $11,595,003 and current liabilities were $579,878, compared with $12,930,473 and $1,426,815, respectively, at end of preceding year.

Nippon Pays in Sterling

Interest on the 6½ per cent bonds of the Nippon Electric Power Company, Ltd., will be paid in sterling in London regardless of the residence of the holder, according to notice received by the New York Curb Exchange from the Chase Harris Forbes Corporation. Several utility companies having outstanding issues of bonds whose interest coupons are payable in any one of several currencies have already announced their interest-paying policies (ELECTRICAL WORLD, January 20, page 134).

Baltimore Financing

New financing, through the issue of $1,100,000 par value of series A preferred stock, is planned by the Consolidated Gas, Electric Light & Power Company, Baltimore. Authority to issue the additional stock has been granted by the Maryland Public Service commission and receipts from the sale of the stock will be used for acquisition of property and reimbursement of moneys not secured or obtained from the issue of stocks, bonds, notes or other evidence of indebtedness actually expended since February 1, 1929.

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Whatever may be the justification of the increasing paternalism we see in nearly all governments today as a means toward recovery, I believe that in America natural causes are contributing more powerfully and that paternalism will disappear here as a part of the reaction from depression.

Gen. JAMES G. HARBORD,
Chairman of the Board,
Radio Corporation of America.

Confidence in the ability of the United States to pull itself out of the depression and go forward without recourse to economic or political changes was expressed this week by General Harbord in an address before the school of politics of the Women's National Republican Club in New York.

Ease Wire and Cable Code

Limited exemption of the wire and cable subdivision of the electrical manufacturing industry from the provisions of Articles IX and X of the industry's code have been announced by Hugh S. Johnson, recovery administrator. The exemptions allowed will permit wire and cable manufacturers to "meet existing competition on products of equivalent design, character, quality or specifications, pending specific provision for such contingencies in a supplemental code for this subdivision or further determination or order" and "to file with the National Recovery Administration any net price list or price list and discount sheet referred to in Article X of said code, and members of said subdivision are exempted from the provisions of said article of said code to the extent, but only such extent, that the same may be inconsistent herewith."

To Market Appliances

Entering the general domestic appliance field with the acquisition of the Audiola Radio Company, which remains under that name as a subsidiary corporation, Fairbanks, Morse & Company has added to its present products refrigerators, washers and radios.

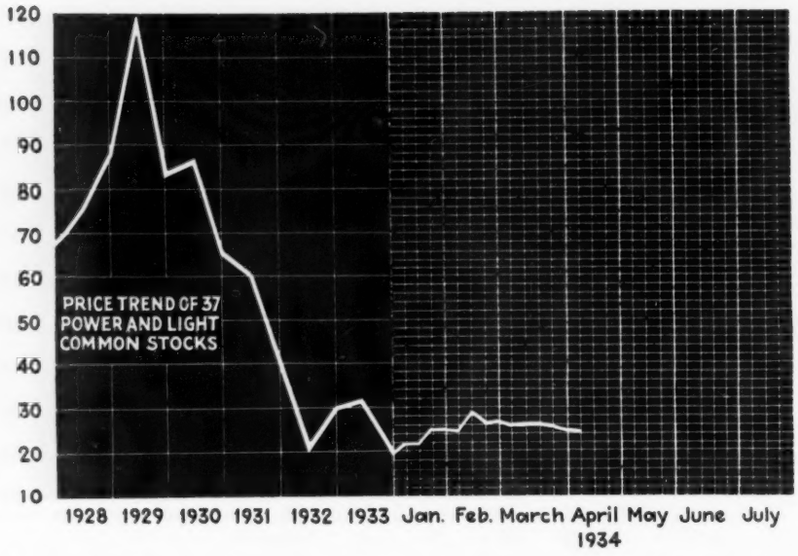
TO THE RIGHT?

More than a hint that the New Dealers are in the midst of one of their not infrequent shifts between left and right appears in the current news from Washington. That the reform motive is being relaxed again is the cumulative lesson of: The automobile strike settlement, progress on the Wagner and stock exchange control bills, recent remarks of administration leaders and outspoken opinions of Messrs. Taylor, Atterbury and Sloan. The voice of Dr. Wirt bears a portent. Even the throttle hold on the capital goods industries (the existing new securities law) gains promise of reasonable revision.

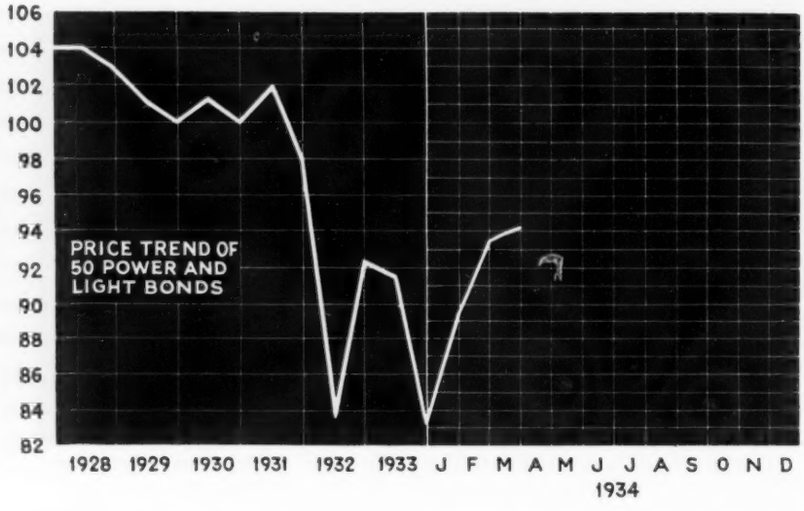
Energy production at the peak for the year tells a story of sustained industrial activity that is most encouraging. Carloadings, off 2.8 per cent for week ended March 24, and steel activity recession for second successive week, as well as declines in automobile output, reflect strike-threat influences. Commodity prices in the month past suffered appreciable declines. Security markets show sustained strength in bonds and a resumption of vitality for equity issues.

All things considered, the outlook for business appears to have brightened considerably.

Bonds Up; Stocks Inactive



Continuing the upward sweep of the past few months, bond prices have risen to new highs, light and power securities following the general list. Stocks, in light trading, show little change for the week or month. "Electrical World" averages: Bonds, 93.4 February, 94.3 March; stocks, 25.3 last week, 25.3 this week.



Deposit $5,000,000 in Debenture Exchange Plan

Nearly $5,000,000 of Pacific Northwest Public Service Company's 6 per cent debentures, of which $15,970,000 are outstanding, have been deposited under a plan providing for a par-for-par exchange for 6 per cent collateral trust income bonds, according to Franklin T. Griffith, president and receiver of the company, now named the Portland Electric Power Company (ELECTRICAL WORLD, February 24, page 313).

Although the plan has been approved by Federal Judge John H. McNary of Portland, Ore., it is being opposed by Halsey, Stuart & Company, Inc., which was in the syndicate that sold the debentures. The Chase Harris Forbes Corporation, the Harris Trust & Savings Bank and H. M. Byllesby & Company have approved the arrangement. Objection of Halsey, Stuart was based principally on that part of the plan providing that holders of the new income bonds might not seek legal redress against the company unless interest totaling 30 per cent was unpaid. Halsey, Stuart proposed instead that income bondholders might seek remedy if at the end of three years there was any accumulated and unpaid interest.

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Federal Cuts Loss

Reduction in net loss to $46,254, as compared with $207,701 in 1932, is noted in the annual report for 1933 of Federal Electric Company. Income from rentals and merchandise sales declined to $3,024,060, against $3,902,542 in 1932. Current assets totaled $1,828,584 and current liabilities $1,007,251 as of December 31, 1933, compared with $1,898,198 and $1,158,055, respectively, at the close of 1932. Accounts payable and accrued interest and taxes were reduced substantially during the year. Deficit at close of 1933 increased to $1,795,002, compared with $1,633,243 the previous year.

Stock Increase Voted for North American L. & P.

Further dilution of Middle West Utilities Company's interest in the North American Light & Power Company resulted from action taken last week by stockholders of the latter company in approving an increase in the capital stock of North American Light by 125,000 shares (ELECTRICAL WORLD, March 17, page 421). The newly authorized shares will be purchased by the North American Company and will retire $2,000,000 of notes which North American Light met this week.

Control of the property formerly rested with North American Company and Middle West Utilities, but because of the inability of Middle West to subscribe to new shares control is now swinging to North American.

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Michigan G. & E. Dividend

Resumption of dividends on its prior-lien stock, which had lapsed since May, 1933, has been announced by the Michigan Gas & Electric Company with the declaration of a dividend of 87½ cents a share on the 7 per cent issue and 75 cents on the $6 prior-lien stock, payable on May 1.

Northeastern P. S. Plans

Nearly completed plans for reorganization of Northeastern Public Service Company provide for a new concern that will issue bonds and preferred and common stock in exchange for Northeastern bonds held by the Chemical Bank and a protective committee headed by James T. Woodward. Under the proposed plan the bonds of the new company will be exchanged for $4,670,000 first lien and collateral trust 5½ per cent bonds, due 1961, and preferred and common stock will be exchanged for $11,680,900 general lien and collateral trust 5½ per cent bonds, represented by the bondholders' protective committee. Details of the plan will be submitted to the Chancery Court in Wilmington, Del., probably this month. New working capital is to be provided by the owner of the first lien bonds through the purchase of common shares of the new company.

G. E. Raises Wages 10% Announces Profit Sharing

A wage increase of 10 per cent, effective April 1, for all General Electric Company employees receiving $2,600 or under has been announced by President Gerard Swope, and submission of a profit-sharing plan designed to affect all employees of the company has been made to stockholders. The wage increase affects both salaried and hour rate employees of the company and increases the payroll by $3,500,000 to $4,000,000. From 38,000 to 40,000 employees will share in the increase.

Under the proposed plan for supplementary compensation, the company's directors are given discretionary authority to set aside in any year out of the earnings of the company available for dividends on the common stock, after deduction of 8 per cent of the average book value of common stock, an amount not in excess of 12½ per cent of the balance of such earnings. Based on present book value of the common stock no participation can result under this plan until the annual earnings available for common stock amount to approximately 83 cents a share. Amount available for common stock dividends in 1933 was 38 cents a share. First quarter common dividends this year are at the rate of 15 cents a share.

The advantage of the new plan is that payments will vary with the earnings of the company, which is in accordance with the theory of profit sharing. Under a previous plan in effect for employees in important and supervisory positions, the earnings of the company from 1916 to 1933, available for common stock, before deducting supplementary and extra compensation, averaged $37,264,000, the extra compensation paid averaged $2,348,000, and the number of participants under the plan averaged 1,912, supplementary compensation being 5 per cent.

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Improve Air Conditioning

To obtain exceptional manufacturing precision for its air conditioners Westinghouse Electric & Manufacturing Company has spent nearly $250,000 to equip a new manufacturing aisle to be a sealed air-conditioned inclosure in which to assemble the units and insure longer trouble-free life. The assembly section is inclosed from floor to ceiling by a paneled partition whose glass windows admit natural daylight. Modern air-conditioning equipment keeps the room free of dust or other foreign particles. Seventy specialized machines prepare the various parts making up the refrigerating units outside the inclosed section; the parts are carried in by conveyors and emerge assembled, sealed and tested cooling units.

Westinghouse Awarded Fort Peck Order

Award of a $500,000 contract to Westinghouse Electric & Manufacturing Company for electrical equipment to be installed at the Fort Peck Dam on the Missouri River, Montana, has been announced by the United States Engineers Corps. The order is for high-tension substation equipment, including four 16,667-kva. and three 1,000-kva. transformers, two 20,000-kva. synchronous condensers, a 60-ton crane and other miscellaneous equipment.

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Timken Shows Profit

Transforming a loss for 1932 into a net profit of $2,172,850, Timken Roller Bearing Company and subsidiaries' report for 1933 shows current assets of $22,828,788 and current liabilities of $1,572,149. This compares with net loss of $482,827, current assets of $19,055,901 and current liabilities of $512,212 at the end of the preceding year.

Electromaster Sales Up

Sales of Electromaster, Inc., electric ranges and water heaters for the first quarter of 1934 were more than 100 per cent ahead of the same period in 1933, according to R. B. Marshall, president of the company. With this the best first quarter in the company's history, unfilled orders as of March 31 are greater than at any time in the past three years, Mr. Marshall stated.

Aluminum Company Shows Profit

Completing 1933 with a net profit of $1,664,547, after depreciation and depletion, Aluminum Company of America and subsidiaries' annual report shows earnings equal to $1.10 a share on the preferred stock, on which dividends of $7.50 a share have accumulated. This contrasts with a net loss of $2,172,732 for 1932. Current assets at the end of the year stood at $75,209,369, including $2,862,878 cash and $23,464,318 marketable securities at cost, and current liabilities were $27,483,798, including bank loans.

New York Metal Prices

	Mar. 27, 1934 Cents per Pound	Apr. 3, 1934 Cents per Pound
Copper, electrolytic	8.00	8.00
Lead, Am. S. & R. price	4.00	4.00
Antimony	7.625	7.625
Nickel ingot	35.00	35.00
Zinc, spot	4.675	4.65
Tin, Straits	54.625	55.625
Aluminum, 99 per cent.	23.30	23.30

Major New Construction This Week

Southern Nebraska Power Company plans improvements and equipment replacements in power plant at Oak, Neb., to replace fire loss, reported over $80,000.

Until April 20, Water and Power Bureau, Los Angeles, Calif., asks bids for one complete carrier current pilot protective relaying equipment for double-circuit, 132,000-volt transmission line between power substations, including all coupling capacitors, potential devices, etc.

Missouri Breweries, Inc., St. Louis, plans multi-story plant. Cost $250,000.

Springfield, Ill., soon takes bids for motors, switchboard, instruments, etc., for city-owned electric light and power plant.

Pittsfield Electric Company, Pittsfield, Mass., plans new double-circuit transmission line between local station and Lee, Mass. Cost over $150,000.

Until May 1, United States Engineer Office, St. Paul, Minn., asks bids for power control, lighting system, etc., at lock and dam No. 5, Mississippi River, near Fountain City, Wis., including dam power feeders, transformers, remote-control switch cabinets, automatic switches, lock lighting system, storage yard lighting system, portable lighting equipment, air signal equipment, etc.

California, Mo., asks bids early in May for complete equipment for city-owned generating plant. Fund of $145,000 available.

Motors and controls, regulators, conveyors, electric hoists, etc., will be installed at Naval Aircraft Factory, Navy Yard, Philadelphia, Pa. A $3,000,000 project.

Sonoma Valley Brewing Corporation, Santa Rosa, Calif., taking bids for brewing plant. Cost $160,000.

Bureau of Reclamation, Denver, Colo., plans call for bids about middle of April for power dam and power plant, Grand Coulee project. This part of program to cost about $25,000,000.

Canadian G.E. Sales Off

Canadian General Electric Company, reporting upon 1933 operations, shows net income, after deducting all charges for costs, expenses, reserves, taxes and depreciation, amounted to $635,176, as compared with $1,165,661 in 1932. Decline in sales of large apparatus was given as the reason for reduced earnings, the year's business being composed principally of electrical merchandise, household appliances, lamps and small apparatus. Current assets stand at $16,579,007 and current liabilities at $1,018,675. Dividend disbursements totaled $1,212,788, exceeding net earnings by $577,613, which amount was charged against surplus, leaving a balance of $6,186,805 in that account at December 31, 1933.

MEN OF THE INDUSTRY

G. W. Van Derzee Assumes New Duties in Milwaukee

Gould W. Van Derzee has been appointed general manager of the Milwaukee Electric Railway & Light Company, according to an announcement made last week by S. B. Way, president. The new general manager has been assistant general manager since 1918 and a vice-president since 1925. He has been active in the commercial and public relations work of his company and has given particular attention to developing rural rates and to extending rural electric service in the territory served. In recent years he also had general supervision over the advertising, commercial, rate accounting, purchasing and stores and publicity departments. Up to the present time Mr. Way held the title of general manager.

Mr. Van Derzee was active in the old National Electric Light Association and in arranging programs for conventions of the Wisconsin Utilities Association, of which he was elected president in 1929.

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NORMAN M. SNIDER, Detroit attorney, has been appointed a member of the Michigan Public Utilities Commission by Governor Comstock.

HARRISON SMITH, president of Imperial Oil Company, Ltd., of Canada, has been elected a director of Canadian General Electric Company.

R. P. SLOAN, well known in electrical finance circles in Great Britain, has joined the boards of several of the electricity companies included in the great Edmundsons group, in which considerable American capital is invested. Mr. Sloan is a pioneer of the electrical industry in the United Kingdom. More than any other man, he has helped to build up the giant North-Eastern Electric Supply Company, of which he is still chairman.

WILLIAM H. O'NEILL, formerly manager of the service department and also active in power sales at the Greenfield (Mass.) offices of the Western Massachusetts Companies, has been appointed district manager of these properties at Easthampton, Mass.

DANIEL M. SHEPARD, a vice-president, and RICHARD L. WHITE, treasurer, of Landers, Frary & Clark, manufacturers of electrical appliances, New Britain, Conn., have been elected directors of that organization. CHARLES P. COOLEY of Hartford has also been elected a director.

FRED E. LITTLEFIELD, formerly of the power sales engineering staff of the Lowell (Mass.) Electric Light Corporation and more recently in the same department of the Worcester Electric Light Company, has been appointed head of power sales engineering in the latter, succeeding Everett D. Learned, whose promotion is recorded below.

A. A. ROWSE has been appointed managing director of the Telsen Electric Company, London, to succeed A. W. MacNamara, resigned. W. Henderson-Cleland has been appointed chairman to succeed J. W. Murray, who has resigned but retains his seat on the board. Mr. Rowse and Mr. Henderson-Cleland were elected to the board by the stockholders at the last general meeting.

EVERETT D. LEARNED, for the past nine years head of the power sales department of the Worcester Electric Light Company, has been appointed north central district power sales engineer for the New England Power Engineering & Service Corporation with headquarters at Leominster, Mass. He will supervise industrial sales for the Wachusett Electric Company (serving the Ayer-Clinton area), Leominster Electric Light & Power Company, Gardner Electric Light Company, Winchendon Electric Light & Power Company and the Athol & Orange Gas & Electric Company.

OBITUARY

A. HOWELL VAN CLEVE, an authority on hydraulics and for eight years chief engineer for the Niagara Falls Power Company, died suddenly April 1 at Fort Myers, Fla., in his sixty-eighth year. Prior to his retirement five years ago, Mr. Van Cleve was engaged as a hydroelectric expert by the United States Government on the Tennessee River dam project. A native of Easton, Pa., and a graduate of Lehigh University, Mr. Van Cleve was the author of several engineering books.

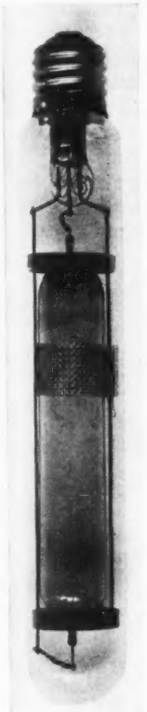
JAMES LYMAN, prominently identified with the engineering profession in Chicago, died March 29 in Del Monte, Cal., while on a visit to the Pacific Coast. Mr. Lyman was a resident of Evanston, Ill., for more than 30 years and from 1911 until his retirement a few years ago had been vice-president of Sargent & Lundy, engineers, of Chicago. He received his education at Yale and Cornell universities and obtained his early experience with the General Electric Company at Schenectady, N. Y. In 1902 he went to Chicago and was made engineer in charge of the G.E. western district, the position he held until 1911. Mr. Lyman was a fellow of the American Institute of Electrical Engineers and a member of the American Society of Mechanical Engineers, the Western Society of Engineers and the Institution of Electrical Engineers of Great Britain.

FREDERIC C. HENDERSCHOTT, formerly executive secretary of the New York Edison Company and manager of the company's bureau of education, died March 30 at his home in North Pelham, N. Y., from the effects of a stroke suffered a year ago. He was 64 years old. A native of Tecumseh, Mich., Mr. Henderschott engaged in newspaper work in various sections of the country before he began his association with the New York Edison Company about 22 years ago as head of its bureau of education, which he organized. He continued in that position until 1930.

HENRY SANDERSON, financier and at one time an officer and director of many electric light and power companies, died March 26, after a long illness, at his home in New York. He was 66 years of age. At an early age Mr. Sanderson became secretary of the Mount Morris Electric Light Company and within a short time was appointed to the same position with the American Electric Light Company and the Yonkers Electric Light Company, all in New York. Subsequently he spent many years with the New York Edison Company, and entered the field of finance in 1905 when he established the firm of Sanderson & Brown. Although a director in several companies at the time of his death, Mr. Sanderson in recent years had reduced the number of his divergent interests.

NEW EQUIPMENT

High-Pressure, 220-Volt Mercury-Vapor Lamps



High-pressure mercury-vapor lamps for 220-volt circuits are announced by the General Electric Vapor Lamp Company, Hoboken, N. J., for use in street lighting, industrial lighting, commercial lighting in combination with sources of a different color, floodlighting, yard lighting, sports areas, and similar tasks. The light-giving tube is approximately 6 in. long and $1\frac{1}{8}$ in. in diameter in a T-16 tipless bulb. This outer bulb is equipped with a mogul screw base and is approximately 13 in. in length over all and 2 in. in diameter. The lamp operates in series with a suitably designed reactor directly on 220 volts a.c. and consumes 400 watts. The efficiency is conservatively rated at approximately 35 lumens per watt.

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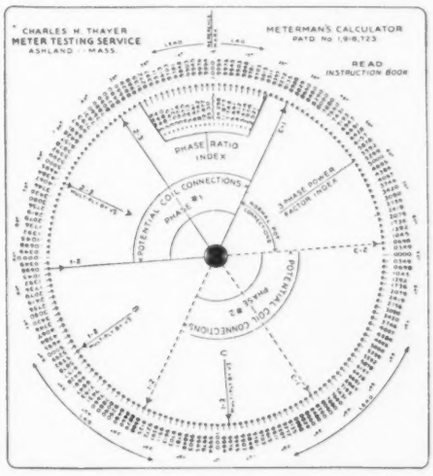
RADIO FIELD INTENSITY METER, type TMV-75-B, for determining the location of radio interference and for making radio transmission surveys has been announced by the RCA Victor Company, Inc., Camden, N. J. The instrument, complete in two carrying cases, consists essentially of an extremely sensitive loop receiver of the superheterodyne type, incorporating a self-calibrating oscillator. The frequency range is from 25 to 20,000 kc., the field intensity range from 20 microvolts per meter to 6 volts per meter and the readings are direct.

POTENTIOMETER PYROMETERS capable of making continuous records of up to four thermocouples and identified as "Galvatron," after the galvanometer-electronic relay circuit employed to operate slide wire resistances and recording pens, have been announced by the Bailey Meter Company, Cleveland. Contact galvanometer is automatically switched from one potentiometer circuit to the next by a synchronous motor, also driving the timing contacts for the relay as well as the recording chart, and automatic standardizing relay contacts. All multi-pen records are continuous in different color ink.

DECORATIVE TUBULAR LAMPS—Virtually an unbroken line of light, so desirable in the decorative treatment of many modern interiors, is obtainable with "Mazda Lumiline" lamps announced by the Westinghouse Lamp Company, Bloomfield, N. J. The Lumiline lamps are based at both ends with a flat disk construction which reduces the dark areas of present base and socket construction to a fraction of an inch. These new incandescent light sources have tungsten filament construction in a T-8 bulb of 1 in. diameter and over-all length of $17\frac{7}{8}$ in. They are available in the 30- and 60-watt sizes, both designed for an average life of 1,500 hours on 110-120-volt service. The compact design minimizes the factor of space limitation and lights can be installed end to end on 18-in. centers. For exposed use they will be made available in colored outside frosted bulbs which give a uniform tube of light.

Meterman's Polyphase Ready Calculator

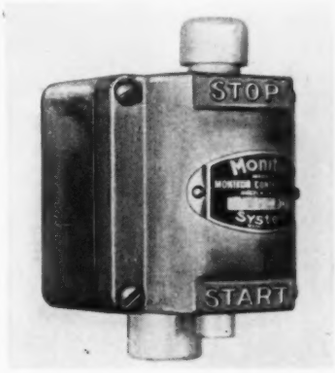
Useful for solving both the practical and theoretical problems encountered by a meterman in connection with three-phase watt-hour meters is the meterman's calculator announced by Charles H. Thayer, Ashland, Mass. Its general object is to permit the determination of correction factors for the reading of a three-phase



meter which has been wrongly connected. Scales permit the determination of three-phase power factor and meter element power factors, provided it is known whether the value is lagging or leading. From the three-phase power factor, correction factors for determining correct meter readings at times when connection errors exist in potential coil, current coil or current transformer connections can be determined.

Push-Button Stations

Push-button pilot-control stations in types for damp or corrosive atmospheres and for locations exposed to the weather have been introduced by the Monitor Controller Company, Bal-



timore. The first type, 9000 M, are oil-immersed push-button stations with contacts operating under oil; umbrella type push buttons and cast iron box construction provide a splash-proof inclosure. The complete switch assembly is mounted on the cover and the box with proper amount of oil is put up after the switch unit is mounted. Type 9000 V is primarily a heavy-duty weatherproof control station with stop button conspicuous and start button protected from accidental pressure as illustrated. Conduit entrance can be made from top, bottom or either side, but stop button must be operative from the top. Stations are available in single, two or three button type and a variety of contact arrangements for machine tool applications and general purposes.

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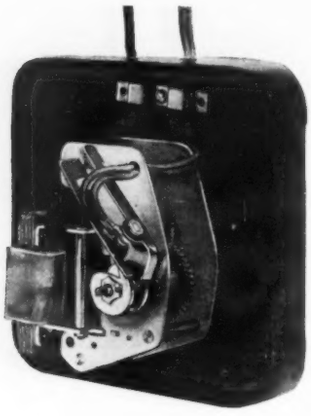
SURGE-PROOF DISTRIBUTION TRANSFORMERS of improved mounting and self-protection design, identified as type CSP, have been introduced by the Westinghouse Electric & Manufacturing Company. Lightning protection is provided by "Deion" gaps in conjunction with the type AB Deion service breakers mounted within the tank. The breakers also provide protection against burnouts from short circuits or overloads. The secondary breakers likewise eliminate the need for primary fuse cutouts. High-voltage protective interlinks are provided to prevent feeder outage from transformer winding defects. Type CSP transformers are available in sizes

from 1½ to 25 kva. for 2,400, 4,800 and 6,900 volts. Simplified mounting by different combinations of hangers eliminates crossarms for some installations. Long leads and hot-line clamps facilitate connections to primary lines.

Small Variable Timers of Repeating Interval Type

Designed for use on electrical equipment requiring continuous interval operations using not more than 3 amp., and with relays for any amperage above three, the Jewel type 10-630-8 timers have been introduced by the Walser Automatic Timer Company, Chrysler



Building, New York. Timing mechanism is operated by a small non-synchronous 110-volt a.c. motor, which rotates through a gear train the camshaft and cams which operate quick-make-and-break single-pole switches with silver contacts. Two cams are mounted on the camshaft, one permanently, the rear cam, and the other by friction and adjustable in relation to the first for different operating times in each shaft rotation cycle.

Timers for a wide range of intervals, operating times and shaft speeds can be had by using different impulse cams, cam friction settings and gear trains. Intervals of from one cycle to eight minutes are available, for instance, with cams for one operation in a 30-minute shaft cycle. The timer is mounted on a cast-iron base with a sheet metal cover, making a dust-proof housing which measures 4x4x2½ in. when closed.

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SWITCHBOARD TYPE OIL CIRCUIT BREAKERS of moderate capacity and identified as type E-47 have been announced by the Condit Electrical Manufacturing Corporation, Boston. They are available for 7,500 volts, 600 amp. and 2,500 volts, 800 amp., both with 25,000 kva. interrupting capacity, and are manual, solenoid or motor operated. Like other new Condit breakers, they have accelerated high-speed mechanism totally inclosed in a rigid cast frame, electrically welded steel plate tank with liner and phase barriers and butt type arcing contacts. Bushings are of one-piece "Bakelain," impervious to moisture and oil.

SHIELDED ARC ELECTRODES for building up steel surfaces of all types except austenitic and designated as "Wearweld" have been introduced by the Lincoln Electric Company, Cleveland. These electrodes are said to deposit in thin layers an air-hardening alloy steel of unusual hardness and toughness, the hardness depending somewhat upon the composition of the base metal. Besides preventing oxidation the shielded arc provides a layer of slag, which further protects the metal from the air and permits the weld metal to solidify in a smooth, uniform bead.

Voltage Regulators With Improved Operation

Voltage regulators using the transformer-commutator principle of voltage control, which provides small increments of voltage without sudden changes or circuit interruption, have been introduced by the American Transformer Company, Newark. Amertran transformer-commutator voltage regulators consist of a tapped transformer, stationary commutator and rotary brushes. In some cases tap-changing switches are employed to increase the range, but the mechanism is so arranged that the load is removed from the particular contact being changed.

This type of regulator is said to equal all other types of voltage regulating equipment and may be designed to regulate up to 100 per cent of the input voltage in steps of 1.2 volts or less, or to cover smaller ranges if desired. They are available for manual, semi-automatic or full-automatic operation for either indoor or outdoor service. Available sizes are 0.25 to 200 kva. for single- or three-phase circuits and for controlling potentials up to 2,400 volts.

These regulators have high electrical efficiency, equal to that of a transformer of equal size, and have practically no effect upon power factor, very low exciting current and cause no wave distortion or interference to radio receivers. In addition, size, weight, cost and noise are lower than the induction type.

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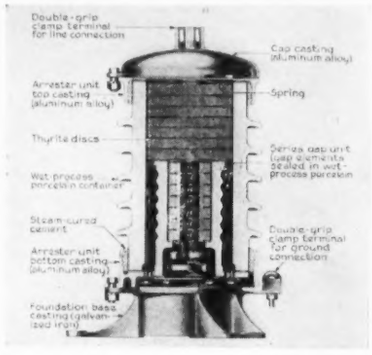
INVERTED CONVERTERS, type H, for supplying a.c. where only d.c. supply is available have been introduced by the General Electric Company, Schenectady, for neon signs, appliances and portable tools. Converter has a single armature and a single frame and is supplied in ratings of from ½ to 20 kva. and for loads between 0.8 and 0.4 power factor.

Thyrite Arrester Improved

In both protective performance and mechanical construction the Form D Thyrite station-type lightning arresters just announced by the General Electric Company of Schenectady represent an improvement over former designs while continuing their unit construction and no-time lag features. The impulse breakdown voltage of the 11.5-kv. unit is about 40-kv. crest. When applying A.I.E.E. standard surge current (1,500 amp.), the impulse voltage acrosss the arrester unit is limited to only 36-kv.


Double-grip clamp terminal for line connection
Cap casting (aluminum alloy)
Arrester unit top casting (aluminum alloy)
Spring
Thyrite discs
Series gap unit (gap elements sealed in wet-process porcelain
Wet-process porcelain container
Steam-cured cement
Double-grip clamp terminal for ground connection
Arrester unit bottom casting (aluminum alloy)
Foundation base casting (galvanized iron)

crest—little more than two times the crest voltage corresponding to the 11.5-kv. r.m.s. rating of the arrester, and representing an improvement of 30 per cent over previous designs. Three-point support and bolting between units of the new arrester simplify assembly and avoid mechanical strains on the wet-process porcelains.

Within the unit the series gap is hermetically sealed, metal caps being bottle-cap-crimped over the ends of the porcelain container, with the gaskets permanently locked in their original compressed position, to exclude moisture and make the operation of the arrester independent of atmospheric influence. Interior elements of type D arrester can be put in the unit housings of existing Thyrite arresters.

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SALT CONCENTRATION BOILER METERS employing standard graphic 110- or 220-volt a.c. ohmmeters to measure the resistance of a column of water in a pressure-reducing chamber at a constant temperature of practically 212 deg. F. have been introduced by the Esterline-Angus Company, Indianapolis. Equipment is designed for boiler room service and records continuously in ohms a measure of the salt concentration in the steam being fed to the turbines so that blowing-down can be used when and only when necessary.